Sedimentation in Plum Creek Subwatershed No. 4, Shelby County, North-Central Kentucky

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1798-G

Prepared in cooperation with the U.S. Department of Agriculture Soil Conservation Service

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By PETER W. ANTTILA

SEDIMENTATION IN SMALL DRAINAGE BASINS

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By Peter W. Anttila

ABSTRACT

The sedimentation investigation of Plum Creek subwatershed No. 4 above Tucker Dam was part of a cooperative nationwide investigation of trap efficiency of detention reservoirs conducted by the U.S. Soil Conservation Service (SCS) and the U.S. Geological Survey.

Runoff from 28 percent of the 1.55-square-mile drainage area passes through several livestock-watering ponds formed by earthfill dams before reaching reservoir No. 4. The principal source areas eroded are thought to be barnyards, plowed fields (10 percent of the subwatershed), grazing land and cropland in SCS land capability class VI, and land cultivated in Lowell soils. The sediment yield from the 1.55 square miles was estimated to be 4.03 tons per square mile per year for the period between March 20, 1957, and April 2, 1959, and 5.44 tons per square mile per year between April 2, 1959, and May 20, 1964. Variations in annual sediment yields are primarily dependent upon the characteristics of runoff. Analyses of sediment records revealed that storm runoff accounted for 93 percent of the 1,860 tons of sediment per year discharged from reservoir No. 4 and that this runoff occurred in 6 percent of the period of investigation, April 1, 1956, to September 30, 1964.

Particle-size analyses of suspended-sediment samples of inflow and outflow indicate that all the sand (generally less than 5 percent of the total suspended sediment) and a substantial amount of the silt and clay entering the reservoir are trapped. If sediment deposition continues at the average rate that was measured during the investigation, 2.15 acre-feet per year, the useful life of reservoir No. 4 will be 46 years.

The trap efficiency, computed from measured weight of sediment outflow and estimated weight of sediment deposition, averaged 92 percent. This value agrees quite well with Brune's (1953) determined value of 94 percent for the average trap efficiency of reservoirs having a similar capacity-inflow ratio.

Because of upstream structures, neither the amount of sediment deposition nor the trap efficiency of reservoir No. 4 should be regarded as representative of similar but unstructured areas in the bluegrass region.

INTRODUCTION

The U.S. Geological Survey, in cooperation with the U.S. Soil Conservation Service, conducted an investiagtion of sedimentation in

Plum Creek subwatershed No. 4, north-central Kentucky, from April 1, 1956, to September 30, 1964. The joint investigation was part of a nationwide investigation of the trap efficiency of detention reservoirs.

The purpose of this report is to present an analysis of sediment data and to determine the trap efficiency of reservoir No. 4. These data, plus similar data for other watersheds, are of value in designing detention structures and in determining the principal factors that influence trap efficiency.

Mr. A. B. Rogers, assistant state conservationist, U.S. Soil Conservation Service, Lexington, Ky., furnished information on land use in the subwatershed, on land capability classes, on reservoir stage-capacity relations, and on bulk density of deposited sediment to 1961. Additional information on reservoir stage-capacity relations and on bulk density of deposited sediment was furnished by Donald A. Parsons, director, U.S. Department of Agriculture Sedimentation Laboratory, Agricultural Research Service, Oxford, Miss. Some of the precipitation records were furnished by the U.S. Weather Bureau.

CHARACTERISTICS OF THE SUBWATERSHED

DESCRIPTION OF THE AREA

Plum Creek subwatershed No. 4 is in southwest Shelby County, Ky., in the north-central section of the State (fig. 1) and is the drainage basin of an unnamed tributary in the west branch headwater area of Plum Creek. The reservoir is formed by Tucker Dam, which is 0.25 mile upstream from the mouth of the tributary. The drainage basin is trapezoidal in shape and has an area of 1.70 square miles (1,089 acres), of which 1.55 square miles (992 acres) is upstream from the dam.

The watershed is in the Outer Bluegrass physiographic subdivision of the Bluegrass region; and it is underlain by Upper Ordovician limestones and shales of the Richmond Stage. The topography is predominantly undulating to rolling, but about 0.6 percent of the subwatershed is classified as nearly level and about 2.5 percent as hilly. Slopes range from 2 to 20 percent.

Soils on the upland area of the subwatershed are Lowell (511 acres), Nicholson (469 acres), Shelbyville (16 acres), Fairmount (10 acres), and Huntington (5 acres). In the bottom lands the soils are Newark (75 acres) and Huntington (3 acres). Table 1 lists the soil types and their areas, slopes, and erosion classes according to land capability classes developed by the Soil Conservation Service. "Land capability is a measure of the need and place for conservation measures. It is an important consideration in land use and choice of appropriate land treatment measures" (J. W. Roehl, written commun., 1967, U.S.

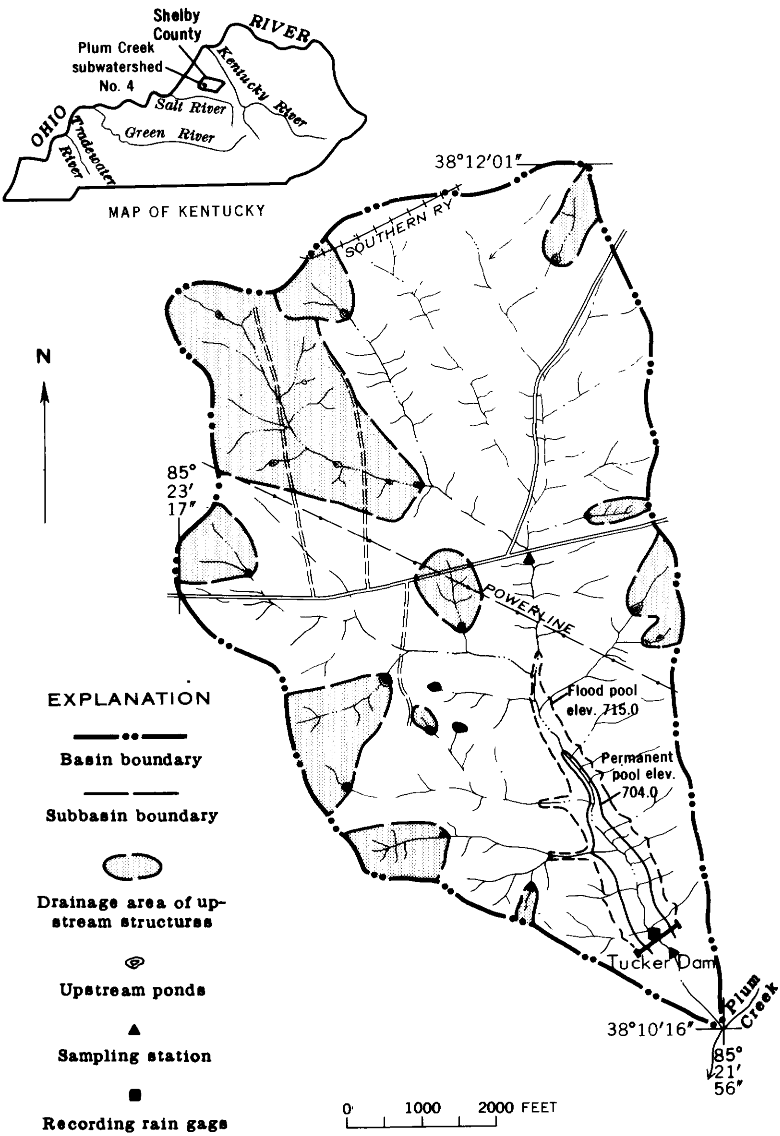

FIGURE 1.—Plum Creek subwatershed No. 4.

Soil Conservation Service). The areas of the five land capability classes in the subwatershed are shown on plate 1 and summarized in table 1.

Land use (plate 1) is predominantly for pasture and crops. About 51 percent of the subwatershed (554 acres) is used for pasture, and about 43 percent (468 acres) is used for cultivated crops in rotation with hay. The remaining land is classed as farmsteads (49 acres),

TABLE 1.—*Land description of Plum Creek subwatershed No. 4*

[Slope class: A, 0–2 percent slope; B, 2–6 percent slope; C, 6–12 percent slope; D, 12–18 percent slope. Erosion class: +, bottomland; 2, moderately eroded; 3, severely eroded; 4, rough and gullied. Land capability classes developed by the U.S. Soil Conservation Service]

Capability class (pl. 1)	Soil type	Slope class	Erosion class	Area (acres) [1]
I	Newark silt loam	A	+	6.25
I	Huntington silt loam	B	+	2.70
II	Nicholson silt loam	B	2	427.50
II	Newark silt loam	B	+	68.85
II	Lowell silty clay loam	B	2	16.70
II	Lowell silt loam	B	2	10.90
II	Shelbyville silt loam	B	2	7.80
III	Lowell silty clay loam	B	3	53.05
III	Nicholson silt loam	B	3	32.35
III	Lowell silty clay loam	C	2	15.70
III	Shelbyville silt loam	B	3	8.50
III	Nicholson silty clay loam	B	3	6.70
III	Nicholson silt loam	C	2	2.10
IV	Lowell silty clay loam	C	3	281.45
IV	Lowell silty clay loam	B	4	26.65
IV	Fairmount silty clay	D	3	10.05
VI	Lowell silty clay loam	C	4	93.10
VI	Lowell silty clay loam	D	3	13.60
VI	Huntington silt loam	D	3	5.05

[1] Areas of five land capability classes summarized.

Capability class	Area within class (acres)	Percentage of drainage area
I	8.95	0.8
II	531.75	48.8
III	118.40	10.9
IV	318.15	29.2
VI	111.75	10.3
Total	1,089.00	100.0

forest (10 acres), and idle land (8 acres). During a 5-year period, 1955–59, the land under cultivation, expressed in percent of the total area of subwatershed No. 4, consisted of the following: hay in rotation, 25 percent; corn, 12 percent; barley, wheat, and oats, 4 percent; and tobacco, 2 percent. Grass cover consists of bluegrass, orchard grass, fescue grass, and white Dutch clover within grass mixtures.

A comparison of land use to land capability (pl. 1) shows that 2 percent of the land under cultivation is in class I, 50 percent in class II, 22 percent in class III, 20 percent in class IV, and 6 percent in class VI. Land is generally plowed for corn and tobacco; however, only 10 percent of the subwatershed is plowed in a given year.

As shown in figure 1, an intensive system of small intermittent streams with straight shallow channels vein the subwatershed. Many small ponds having earthfill dams with emergency spillways as the only discharge facility are scattered along these streams. These ponds were in existence throughout the period of investigation and were used only for livestock-watering purposes. Figure 1 shows 11 significant drainage areas from which runoff must pass through one or more small structures before entering reservoir No. 4. These 11 drainage areas have a combined net area of 275 acres, or 28 percent of the subwatershed above Tucker Dam. The effect of the structures on sediment yield to reservoir No. 4 is discussed in the section on "Sediment yield."

CLIMATE

The climate of Plum Creek subwatershed No. 4 and north-central Kentucky is continental and shows notable variations in temperature and precipitation (Anderson, 1959). These variations result from storms in the belt of the westerly winds that move across the State. Occasional cold and hot spells of short duration are common in the winter and summer, while temperatures are more uniform in the spring and fall. At the U.S. Weather Bureau station at Shelbyville, Ky., about 8 miles northeast of reservoir No. 4, the long-term mean monthly temperature range is from 36°F in January to 77°F in July. The frost-free season, when most erosion occurs, has an average length of 173 days, between the last frost occurrence on April 25 (average) and the first frost occurrence on October 15 (average).

The long-term average annual precipitation at Shelbyville is about 47 inches; the annual precipitation for the period April 1, 1956, to September 30, 1964, averaged about 41 inches (fig. 2). Figure 2 shows

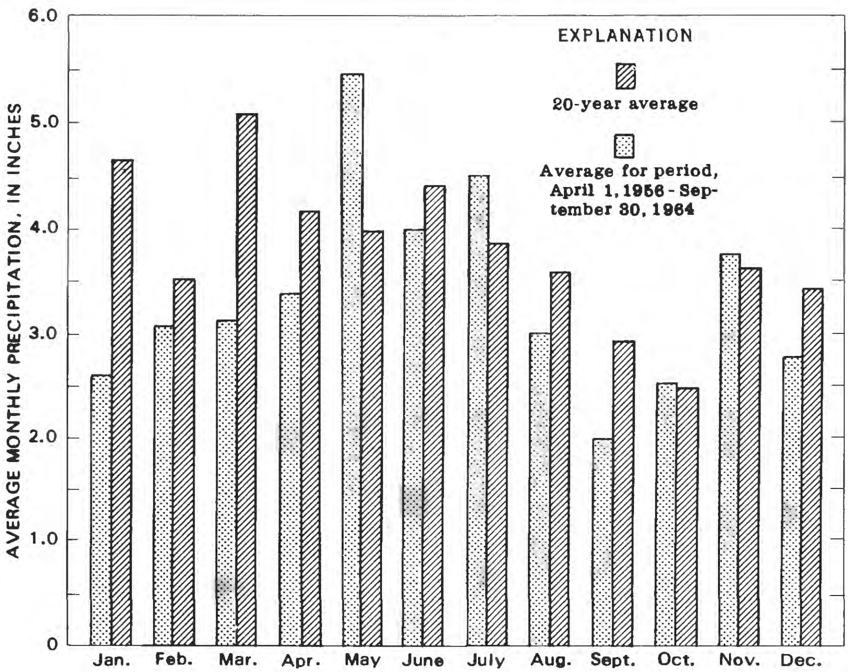

FIGURE 2.—Average monthly precipitation in Shelbyville, Ky.

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that much of the deficiency occurred during the January to April period, when sediment concentrations are generally lower. Therefore, the effect of below-normal precipitation during the project period on total sediment yield was relatively small.

Approximately one-half the average annual total precipitation occurs during the warm season, between April and September. Thunderstorms of high-intensity rainfall are the principal contributors during that season. The rainfall from these storms in a 24-hour period frequently exceeds 3 inches and occasionally reaches 5–6 inches. The mean number of days with thunderstorms ranges between 45 and 60 per year. The effect of storm intensity and duration on sediment yields and concentrations in subwatershed No. 4 is illustrated in the section on "Suspended sediment."

DESCRIPTION OF DAM AND RESERVOIR

Reservoir No. 4 (fig. 3), completed in the fall of 1954, is about 4,200 feet long and 300–600 feet wide at flood-pool stage, which is at a gage height of about 27.0 feet. The left bank of the reservoir is comparatively straight. On the right bank, two drainage channels enter the reservoir about 1,300 and 2,000 feet upstream from the dam, respectively, forming coves 500–600 feet in length. At sediment-pool level (gage height of 15.18 ft, or elev 703.2 ft) the reservoir is

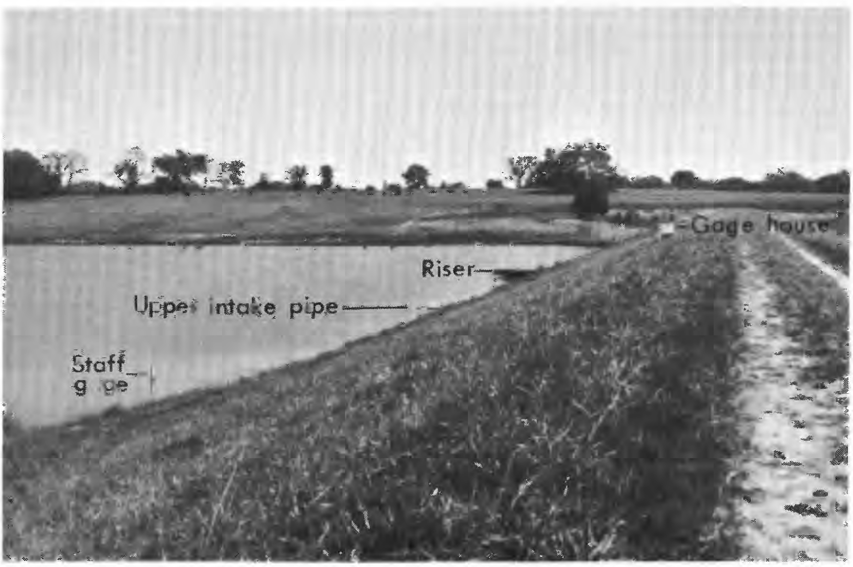

FIGURE 3.—Upstream face of dam showing staff gage, upper intake pipe, gage house, and riser. Reservoir stage is about 15.2 feet.

200–400 feet wide and about 1,900 feet long with a narrow neck of backwater extending another 800 feet.

The area and capacity at 1-foot increments of elevation for reservoir No. 4 are given in table 2. The storage in the floodwater retarding pool, between the sediment pool and the emergency spillway, represents about 3.4 inches of runoff from the subwatershed. Storage in the sediment pool is 99.6 acre-feet, or 25 percent of the total available storage behind the dam. Additional provisions were made in the design of the structure to accommodate sediment deposition in the floodwater retarding pool. The designed storage space for sediment was determined by a sediment-source survey of the subwatershed.

TABLE 2.—*Stage, capacity, and area of reservoir No. 4 (as designed)*

[Table furnished by Soil Conservation Service]

Elevation (ft above mean sea level)	Gage height (ft)	Capacity (acre-ft)	Surface area (acres)	Remarks
688. 04	0. 00	----------	----------	Gage datum.
689	. 96	0. 00	0. 00	
690	1. 96	. 02	. 10	
691	2. 96	. 06	. 75	
692	3. 96	1. 70	1. 62	
693	4. 96	4. 20	2. 76	
694	5. 96	7. 49	3. 95	
695	6. 96	12. 40	5. 22	
696	7. 96	17. 83	6. 18	
697	8. 96	23. 90	6. 96	
698	9. 96	31. 97	7. 74	
699	10. 96	40. 70	9. 04	
700	11. 96	50. 55	10. 54	
701	12. 96	61. 80	11. 48	
702	13. 96	73. 56	12. 17	
703	14. 96	86. 70	12. 94	
704	15. 96	99. 57	13. 76	Elevation of principal spillway.
705	16. 96	113. 14	15. 07	
706	17. 96	130. 43	17. 17	
707	18. 96	149. 94	19. 79	
708	19. 96	170. 17	22. 69	
709	20. 96	194. 34	25. 55	
710	21. 96	221. 29	28. 55	
711	22. 96	252. 84	31. 55	
712	23. 96	284. 11	34. 36	
713	24. 96	321. 41	37. 30	
714	25. 96	360. 81	40. 24	
715	26. 96	400. 07	43. 11	Elevation of emergency spillway.

The reservoir outlet consists of a concrete riser, 4 feet square in cross section and 14 feet high. The top of the riser, 15.96 feet gage datum, has rounded inside corners. The upstream face is cut with a sharp-crested 120-degree V-notch wier at elevation 15.18 feet. An antivortex baffle is installed in the top of the riser with the bottom of the baffle at elevation 17.2 feet. The water is carried through the

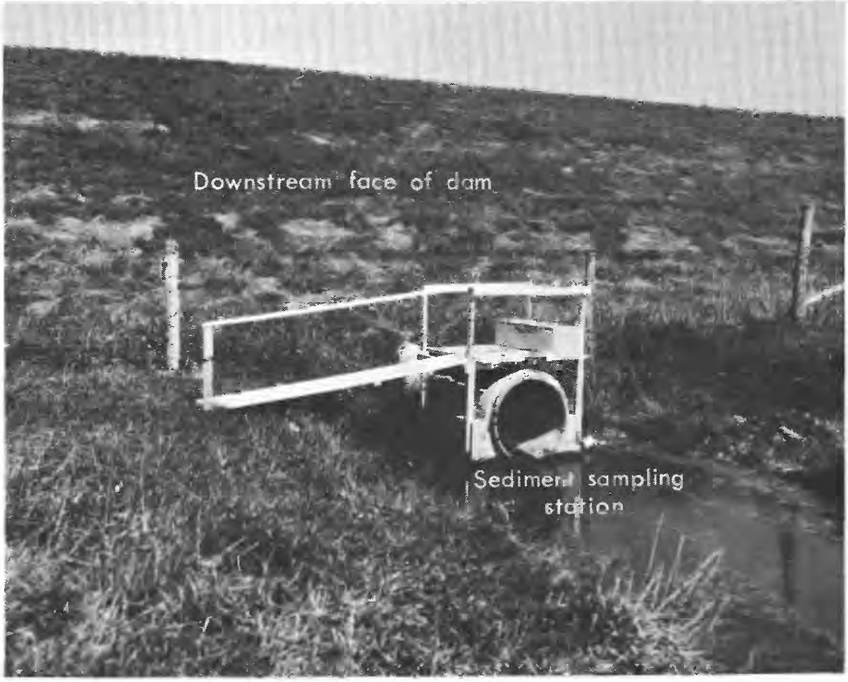

FIGURE 4.—Downstream face of dam showing outlet sediment-sampling station. Reservoir stage is about 15.2 feet.

dam in a 36-inch diameter reinforced concrete conduit, 164 feet in length (fig. 4). A vegetated earth emergency spillway, 75 feet wide at elevation 27.0 feet, is at the left end of the dam. The reservoir gage datum, based on levels determined by the Soil Conservation Service, is 687.99 feet above mean sea level.

RUNOFF

No attempt was made to gage the runoff from the subwatershed into the reservoir during the investigation; however, by using the principle of continuity, inflow hydrographs were computed for significant storm runoffs. The continuity equation for any time interval is

$$\overline{Q}_i+P=\overline{Q}_o\pm\Delta S+C$$

where

$\overline{Q}_i$=average inflow,
P=precipitation on the pool surface,
$\overline{Q}_o$=average outflow,
ΔS=change in pool storage, and
C=pool consumption, which includes losses by evaporation and seepage. It is recognized that seepage is not a true loss when it contributes to ground water.

A minimum time interval of 15 minutes was used in the computations. In the computations the term "C" was not included because the volume effect of evaporation and seepage losses was insignificant for the short time intervals used. The outflow, $\overline{Q}_o$, was determined from the stage-discharge rating curve for the conduit outlet. The stage-capacity-area table provided by the Soil Conservation Service (table 2) was used to determine the values of ΔS. The table represents the original storage content. No adjustments for sediment deposition were necessary for determining storage changes, because no changes occurred in the stage-area relation during the investigation. Figures 5 and 6 are the hydrographs of two of the largest storm runoffs during the period of investigation. The peak inflow of the March 5–6, 1961, storm was about 980 cfs (cubic feet per second) (average for 15 min). This was the maximum instantaneous inflow during the period of study. The runoff event beginning May 7, 1961, and ending May 9, 1961, contributed 4.53 inches, the greatest runoff of any event during the period of study. It is noted that the upstream livestock-watering ponds, controlling runoff from 28 percent of the area, caused some reductions in peak rates of inflow and water yield.

Inflow was determined on an annual basis by assuming that the precipitation on the pool surface for any one year would approximately equal pool consumption. The continuity equation is thus simplified to read $\overline{Q}_i=\overline{Q}_o+\Delta S$; ΔS will be insignificant on an annual basis, and so $\overline{Q}_i=\overline{Q}_o$. On the basis of these assumptions, the average annual runoff into reservoir No. 4 during the investigation was estimated to be 14.9 inches (1,231 acre-ft). The estimated value $\overline{Q}_i=\overline{Q}_o$ on an annual basis was compared with the annual totals of daily inflow computed by the continuity equation, and a 3 percent difference was found between the two methods. No flow occurred 30 percent of the time at the reservoir outflow.

Data were not sufficient to permit computation of pool consumption. The estimated long-term monthly mean evaporation loss for reservoir No. 4, based on representative values for the region (American Society of Civil Engineers, 1949, p. 127, table 15), was 3.0 inches depth (3.4 acre-ft), with a range from 0.8 inch depth (0.9 acre-ft) in January and December to 5.7 inches depth (6.5 acre-ft) in July. On the basis of this average rate of evaporation and an average annual precipitation of 41 inches (the average annual rate during the period of investigation), seepage from the pool was estimated to average 5 inches annually.

SUSPENDED SEDIMENT

METHODS OF SUSPENDED-SEDIMENT INVESTIGATION

On November 12, 1954, a continuous-stage recorder was installed to obtain reservoir elevations. A tipping bucket-type rain gage was

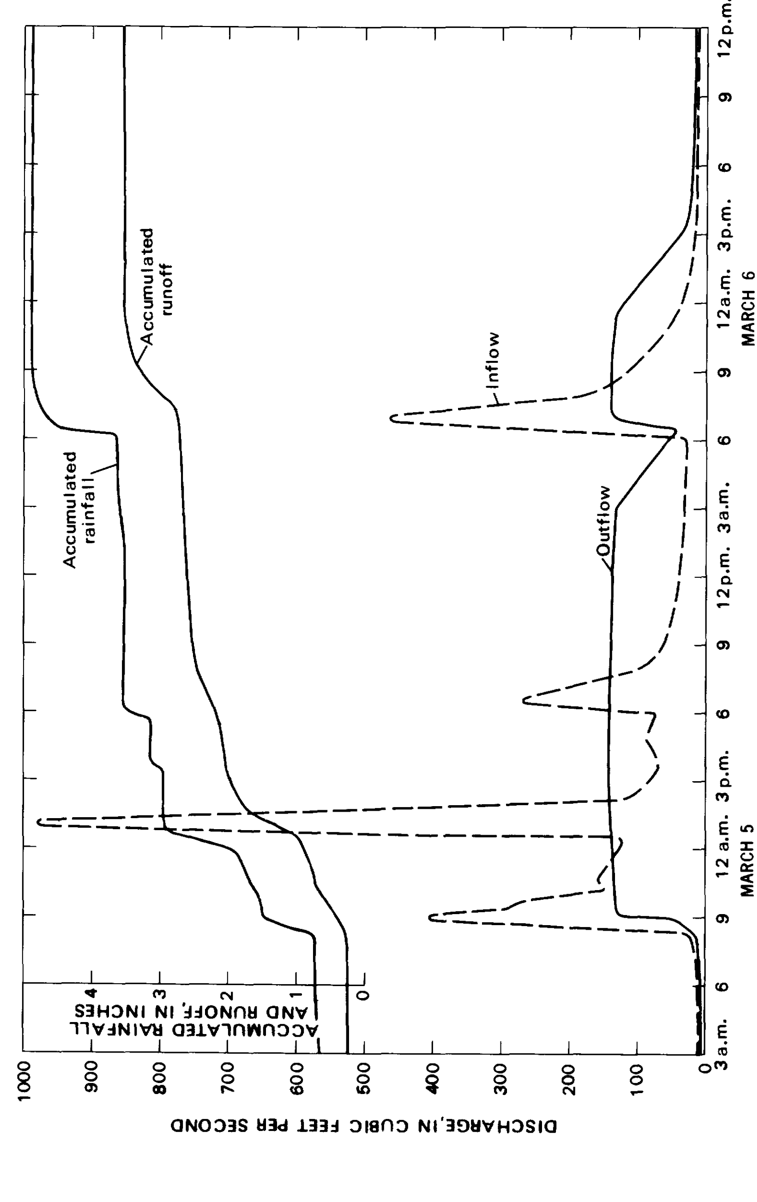

FIGURE 5.—Water discharge (inflow and outflow), accumulated rainfall, and accumulated runoff, reservoir No. 4, March 5–6, 1961.

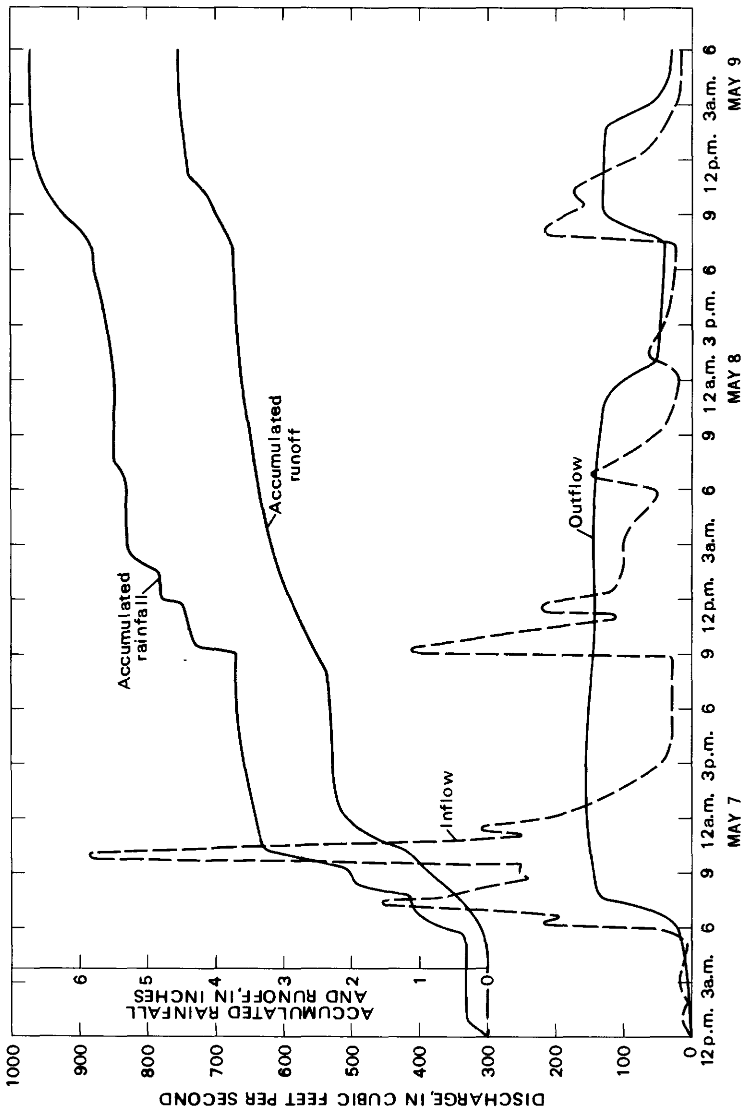

FIGURE 6.—Water discharge (inflow and outflow), accumulated rainfall, and accumulated runoff, reservoir No. 4, May 7–9, 1961.

installed and operated in conjunction with the stage recorder. A recording rain gage was also installed near the northeast corner of the subwatershed. Water-discharge measurements were made below the conduit outlet to define a stage-outflow rating.

Sampling of the reservoir outflow for the computation of daily sediment load began April 1, 1956, and ended September 30, 1964. Samples were taken daily during periods of uniform flow and at more frequent intervals during periods of storm runoff. The samples were collected with a U.S. DH–48 sampler from a platform constructed over the end of the outlet pipe. (See fig. 4.)

Inflow to the reservoir was sampled 15–29 times a year with a U.S. DH–48 sampler at the highway bridge approximately 1 mile upstream from the dam (figs. 1, 7). The samples were collected at about the peak inflow of each appreciable storm runoff and were analyzed for particle-size distribution and for instantaneous concentration. The particle-size distributions were considered representative of all inflow to the reservoir for their respective storm runoffs. Sampling of inflow and outflow was done by local observers, who were assisted by Geological Survey personnel during periods of major runoff.

The suspended-sediment concentration, in parts per million, of all outflow samples was determined in the laboratory by decanting, filtering, drying, and weighing; the concentrations were then converted to milligrams per liter. The concentration of each sample and the gage-height trace were used to construct a continuous concentration curve. The curve and the water-discharge record were used to calculate the daily mean concentration and daily suspended-sediment discharge. On days when the concentration and water discharge changed rapidly, the daily loads were computed by subdivision. On days when no samples were taken, daily loads were estimated or computed from an estimated concentration graph.

Particle-size distribution of the suspended sediment in selected samples was determined, in percent by dry weight, by the sieve and bottom-withdrawal methods. The sand fractions were defined by wet sieving. The silt and clay fractions were determined by the bottom-withdrawal method in a distilled-water settling medium to which the dispersing agent sodium hexametaphosphate was added. The resulting particle-size distribution approximated that of the primary particles. Most of the inflow samples and some of the outflow samples were split into two parts and analyzed (1) in the dispersing medium and (2) in native stream water.

Sediment deposition and density of deposits in reservoir No. 4 were determined from four reservoir surveys conducted by the U.S. Soil Conservation Service, Lexington, Ky., and the U.S. Agricultural Research Service.

FIGURE 7.—View downstream from inflow sampling site at the highway bridge approximately 1 mile upstream from the dam.

SEDIMENT YIELD

The sediment delivered to reservoir No. 4 does not represent all the material eroded in the 1.55 square miles of drainage area above Tucker Dam. As stated previously, runoff from 28 percent of the area must pass through upstream structures that undoubtedly trap most of the sediment from their basins except during major storm runoffs when water stages are above spillway elevations. The lack of quantitative data on sediment yields from different parts of the subwatershed prevents the establishment of a relation of land use to sediment yield from the 11 areas shown in figure 1 for any given year, or any given storm. It is believed, however, that the principal areas of erosion in subwatershed No. 4 are barnyards, where livestock have destroyed the vegetal cover, plowed land in areas of land capability class VI, cultivated land in Lowell soils, and pastureland with excessive grazing of cattle in areas of land capability class VI. Significant erosion on the 17 miles of defined channels and 5 miles of road has been prevented by vegetal cover. In the 11 basins affected by on-channel structures, the principal source areas of erosion and 8.6 acres of powerplant area amount to only 4 percent of the subwatershed above Tucker Dam. The 8.6 acres of powerplant area is in the urban area in the northwestern part of the subwatershed (pl. 1). Construction in this area was frequent during the last 5 years of the investigation (1960–64).

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An estimate of total sediment yield from subwatershed No. 4 above Tucker Dam was made by assuming that all sediment deposited in the reservoir came from the 717 acres (1.1 sq mi) of drainage area not affected by upstream structures. The sediment derived from the 717 acres and delivered into reservoir No. 4 is equal to the sediment deposited (table 5) plus the sediment discharged from the reservoir (table 6). On this basis, the sediment yield from subwatershed No. 4 was 4.03 tons per square mile per year during the period between March 20, 1957, to April 2, 1959, and 5.44 tons per square mile per year during the period between April 2, 1959, and May 20, 1964.

The inflow to reservoir No. 4 was sampled for particle-size analyses at about the peak of appreciable storm runoffs. These samples were also used to define a sediment transport curve, showing the relation of the instantaneous suspended-sediment discharge to instantaneous water discharge. From the sediment transport curve, the maximum inflow (980 cfs on March 5, 1961) during the period of investigation would have resulted in a suspended-sediment discharge of about 10,600,000 pounds per day. The probable suspended-sediment concentration at this instant was approximately 2,010 mg/l (milligrams per liter). Significant storm runoffs producing peak inflows of 100 cfs and 500 cfs contributed instantaneous suspended-sediment discharges of about 540,000 and 4,400,000 pounds per day, respectively. Of course, inflow rates of these magnitudes were of short duration. Previous investigations have shown that in small watersheds similar to Plum Creek subwatershed No. 4, where the stream channel contains little flow prior to storm runoffs, the peak concentration of suspended sediment coincides with the peak flow, or somewhat precedes it. It is assumed in this report, therefore, that the peak suspended-sediment discharge into reservoir No. 4 during a storm runoff probably is accompanied by the peak concentration of suspended sediment.

Erosion in subwatershed No. 4 is chiefly sheet and rill erosion, referred to collectively as sheet erosion. Serious erosion effects such as gullying do not occur. Sheet erosion is more or less the uniform removal of soil or soil material from an area by the action of rainfall and runoff. According to Millar, Turk, and Foth (1962, p. 394), if sheet erosion is to occur alone, it is necessary that the soil surface be virtually smooth. This is seldom true, for usually a soil surface contains small depressions in which water will accumulate and eventually overflow at the lowest point, cutting a tiny channel as it moves down slope. Duplicated at innumerable points, this process creates a surface cut by a multitude of very shallow trenches called rills. When none of these rills grow to an appreciable size or depth (appreciable depth is 6 in.), the surface soil is rather uniformly removed. Smith and Wischmeier (1957) discussed in detail the processes by which sheet erosion occurs and the factors which effect the magnitude of the losses.

The predominant factor in the variation of annual sediment yield from the subwatershed is the nature of precipitation during major storm events, which are of two types: (1) intense thunderstorms common during spring and summer months and (2) winter storms of longer duration. The summer storms produce greater rates of overland flow causing high erosion rates, whereas the winter storms are less intense and generally cause low rates of erosion. During prolonged periods of rainfall in the winter, however, sheet and rill erosion can become quite severe.

J. C. Mundorff (written commun., 1967) observed in the Great Plains that erosion in the winter, when surface vegetation is at a minimum, is initiated when the surface layer of soil (an inch or less in thickness) is thawed by rainfall. Because this thin surface layer is underlain by an impermeable frozen layer of soil, it rapidly becomes, with additional rainfall, completely saturated and may become semi-fluid. The result is erosion that produces significant quantities of sediment. The same erosion process has been observed in Ohio and is thought to occur in the Bluegrass region.

A seasonal effect on sediment yields is shown by the two sediment transport curves in figure 8. Fifty storm events were selected to define the curves. The slopes of both curves indicate that an increase in water discharge is accompanied by a greater increase in sediment load. A seasonal effect is observed, however, only for water discharge less than 45 cfs-days per storm, with the rate of increase in sediment discharge being greater during the warmer months. The sediment transport curve for the summer months represents all larger storm events. The single curve for large storm events indicates that the sediment yields in the fall and winter months during prolonged periods of rainfall are similar in quantity to sediment yields during the intense rainfall storms in the spring and summer.

SEDIMENT OUTFLOW

The continuous record of suspended sediment discharged from reservoir No. 4 for the period April 1, 1956, to September 30, 1964, is shown in table 6. As a result of storm runoff, sediment discharge from the reservoir at the rate of 1,000 pounds per day or more prevailed during 6 percent of the period. The storm runoff represents 57 percent of the total water discharge and 93 percent of the total of 1,860 tons of sediment discharge from reservoir No. 4. The discharge-weighted mean concentration of sediment in the storm outflow is 223 mg/l; this is the concentration that would result if all the water and all the sediment discharged during a given period were uniformly mixed (Mundorff, 1966, p. C16). If the remaining 42 percent of the outflow with a weighted concentration of 23 mg/l

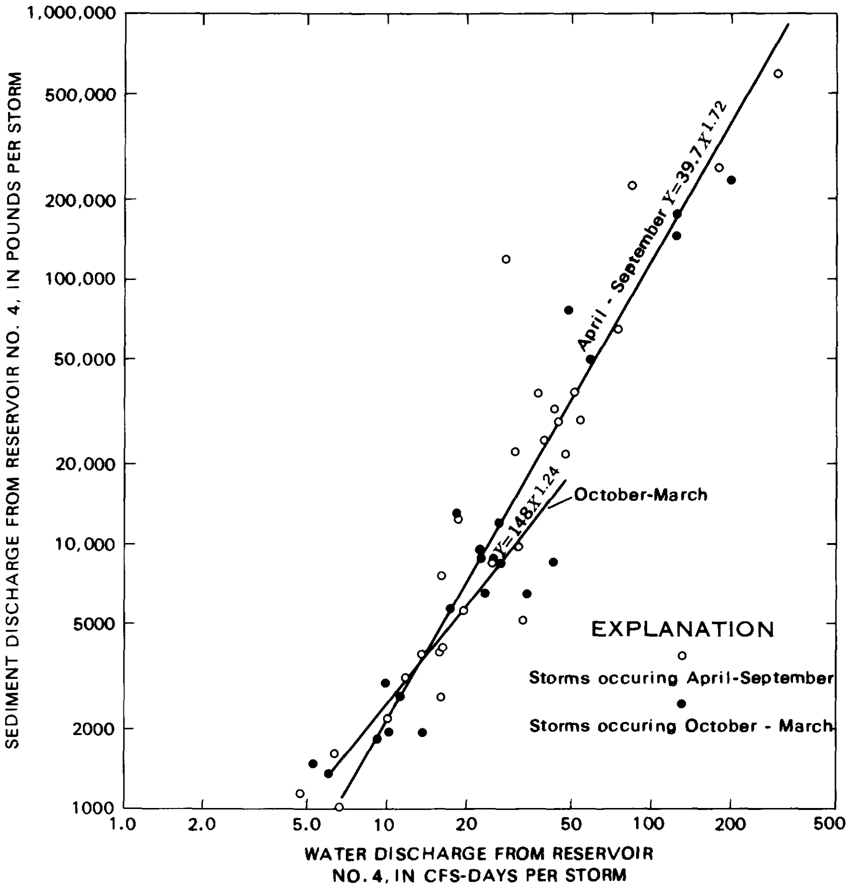

FIGURE 8.—Suspended-sediment transport curve on a storm event basis, April 1956 to September 1964. Y, pounds; X, cfs-days.

were included, the total water discharge from the reservoir would have a weighted mean concentration of 138 mg/l.

Two runoff events, one in the winter and one in the summer, can be used to illustrate the characteristics of the suspended sediment discharged from reservoir No. 4. The winter runoff event of February 23–28, 1962, produced the longest duration of storm outflow from reservoir No. 4. This event is characteristic of winter storms in the region. The hydrologic information for reservoir No. 4 during this period is shown in figures 9 and 10.

This winter runoff event was the consequence of three storms of moderate to low rainfall intensity. Table 3 contains hydrologic data relative to the three storms composing the runoff event. The peak suspended-sediment concentrations of the outflow for the first two storms coincided with peak water discharges. The peak concentration

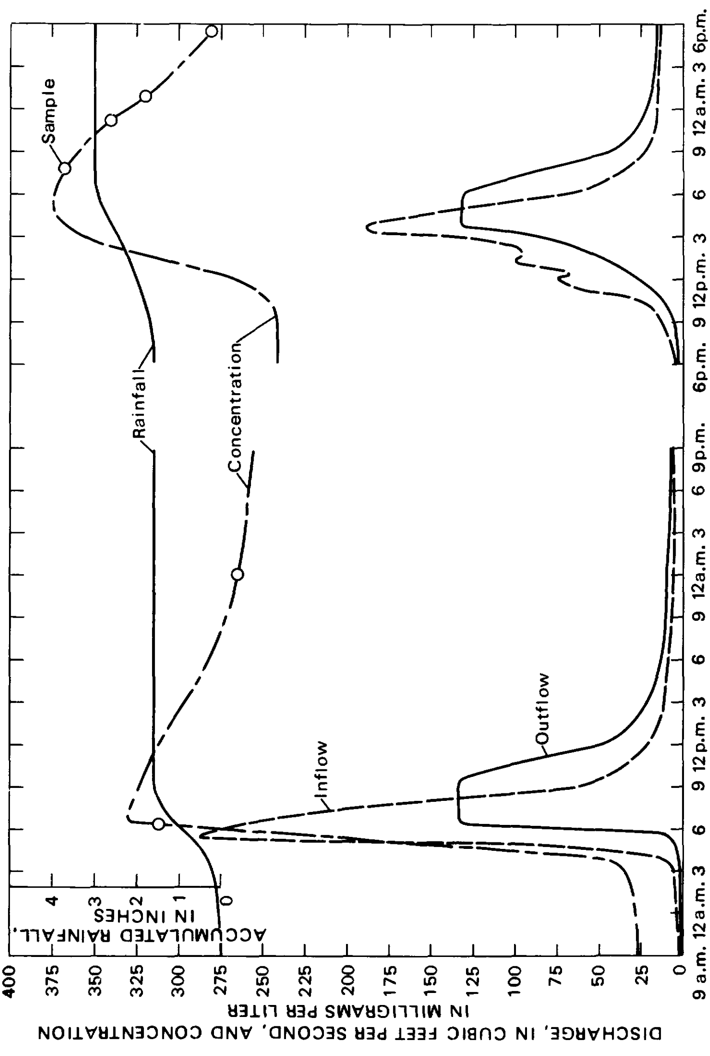

Figure 9.—Water discharge (inflow and outflow), accumulated rainfall, and suspended sediment concentration, reservoir No. 4, February 23–26, 1962. (Hydrologic information continued in fig. 10.)

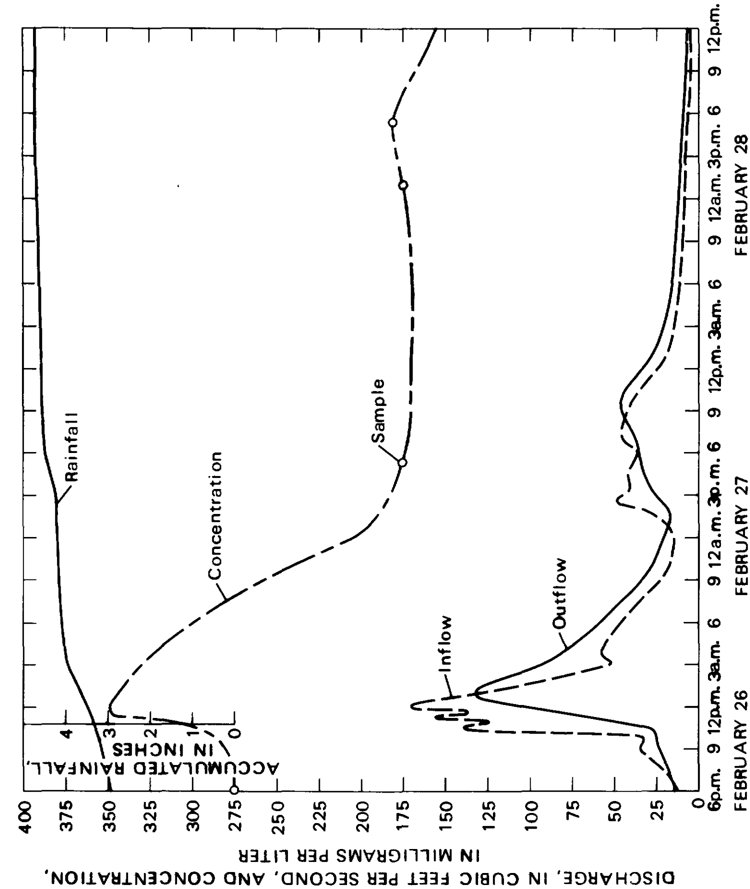

FIGURE 10.—Water discharge (inflow and outflow), accumulated rainfall, and suspended sediment concentration, reservoir No. 4, February 26–28, 1962.

TABLE 3.—*Hydrologic data for runoff event of February 23–28, 1962, reservoir No. 4*

Date of single storm	Rainfall duration (hr)	Rainfall (in.)	Maximum rainfall intensity (in. per hr)	Peak inflow (cfs)	Peak outflow (cfs)
Feb. 23	12	1.60	0.41	287	136
25	10	1.40	.20	190	132
26–28	48	1.70	.17	170	129

Date of single storm	Peak suspended-sediment concentration (mg/l)	Maximum instantaneous suspended-sediment discharge (outflow)		Total suspended-sediment discharge (outflow)	
		Pounds per day	Tons per day	Pounds	Tons
Feb. 23	330	242,000	121.0	71,900	35.95
25	375	267,000	133.5	83,400	41.7
26–28	350	239,000	119.5	90,400	45.2

for the third storm preceded the peak outflow; however, the maximum instantaneous sediment discharge occurred with the peak outflow. Previous to the runoff event, temperatures were relatively cold (low twenties, Fahrenheit). The ground during this time was frozen and consequently resistant to erosion. The storm of February 23, accompanied by warmer temperatures, thawed the topsoil and caused some erosion. By the start of the second storm, on February 25, the soil was less resistant to erosion, and thus although of lower rainfall intensity and shorter in duration than the February 23 storm, it produced a greater maximum instantaneous sediment discharge and a higher total sediment discharge. The increase in the quantity of soil ready for transport is reflected further by the data for the storm of February 26–28, for concentrations of suspended sediment relative to the outflow were highest during this storm. The three storms during the 6-day period, February 23–28, resulted in 4.70 inches of rain and a total suspended-sediment load of 245,700 pounds (122.85 tons). This load was 52 percent of the total suspended-sediment load discharged from reservoir No. 4 for the 1962 water year and about 7 percent of the total load for the period of record, 1956–64.

The other runoff event that illustrates the characteristics of suspended-sediment discharge occurred on June 22–24, 1960, and was the consequence of two thunderstorms of high intensity rainfall that were separated by a lull of 2½ hours. Hydrographs of this event are shown in figure 11. The two storms produced 3.70 inches of rain during an 8-hour period. The maximum rainfall intensity, which occurred during the first storm, was about 4.00 inches per hour.

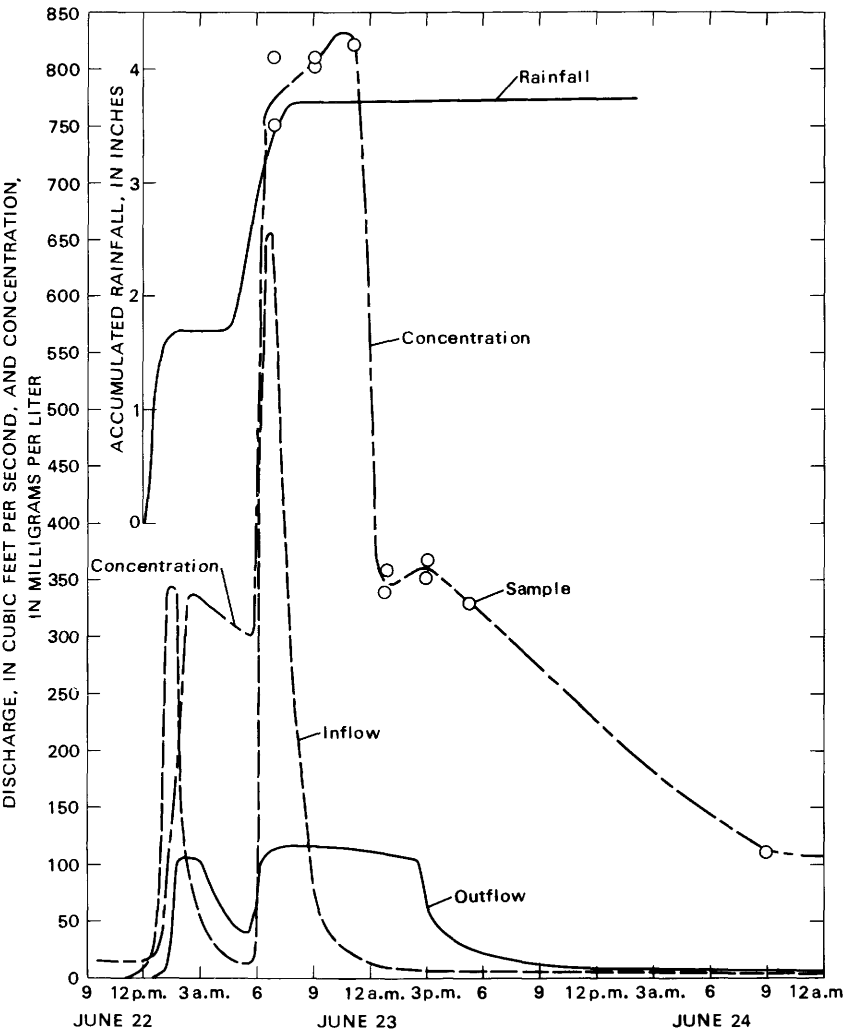

FIGURE 11.—Water discharge (inflow and outflow), accumulated rainfall, and suspended-sediment concentration, reservoir No. 4, June 22-24, 1960.

Other data for the event are as follows: Peak inflow, about 655 cfs; peak outflow, 115 cfs; peak suspended-sediment concentration of outflow, 830 mg/l; maximum instantaneous sediment discharge, 514,000 pounds (257 tons) per day; and total sediment discharge, 183,000 pounds (91.5 tons). The sediment discharge from the event represents 47 percent of the total for the 1960 water year and about 5 percent of the total for the period of record, 1956–64.

PARTICLE SIZE OF SUSPENDED SEDIMENT

The particle-size distribution of suspended sediment (fig. 12) indicates that all the sand and a substantial amount of the silt entering reservoir No. 4 are trapped. The resulting sediment outflows are predominantly clay.

The particle-size distribution analyses of inflow samples and of selected outflow samples are given in tables 7 and 8, respectively. The average particle-size distributions of inflow are shown in figure 13 for samples analyzed in distilled water with a dispersing agent and in figure 14 for samples analyzed in native water; four ranges of suspended-sediment concentration are summarized in table 4. Several of the native-water analyses were not included because of their questionable accuracy. The particle-size distributions show that the percentage of clay tends to decrease as the suspended-sediment concentration increases, whereas the percentage of silt tends to increase.

The average particle-size distribution for sediment outflows, which was obtained by averaging the data from the two settling media, is shown in figure 15. The particle-size data were not separated into

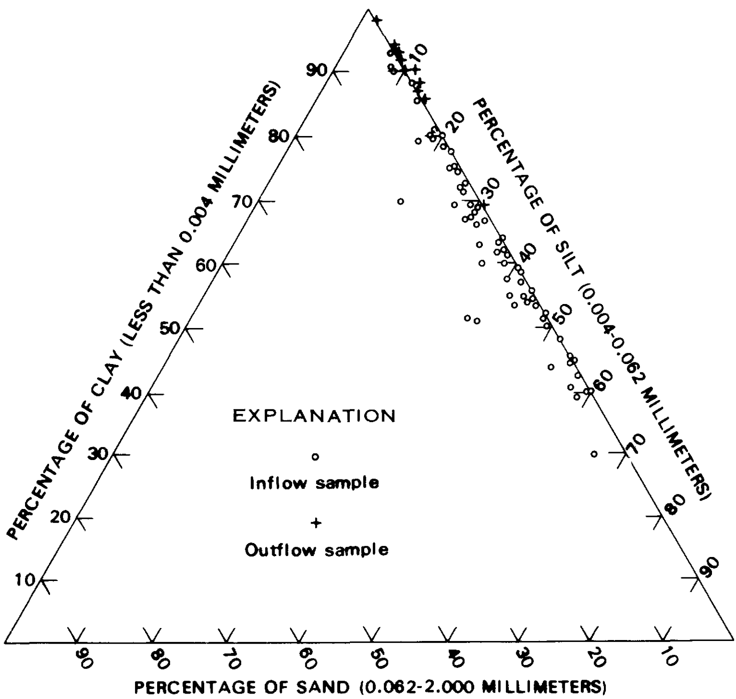

FIGURE 12.—Percentage of clay, silt, and sand in inflow and outflow samples from Plum Creek subwatershed No. 4.

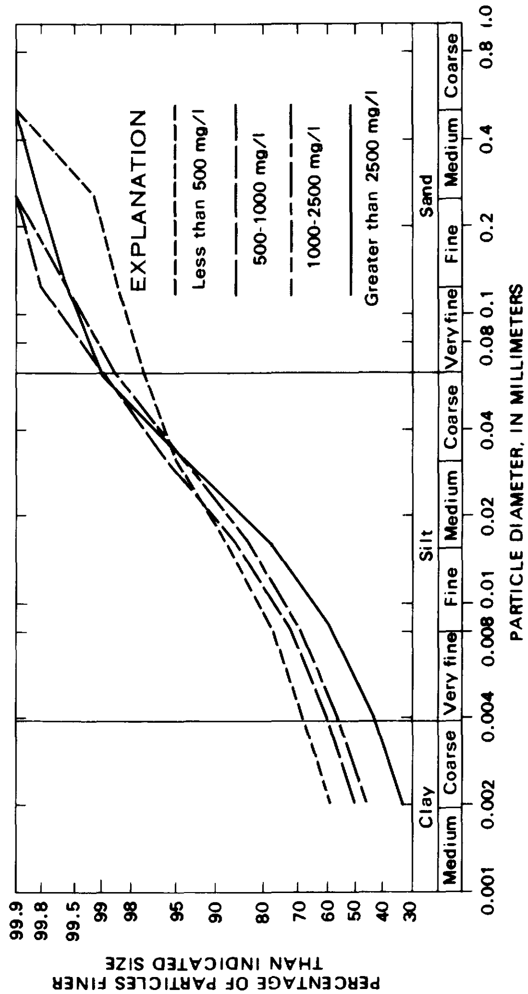

FIGURE 13.—Particle-size distribution of suspended-sediment inflow analyzed in settling medium of distilled water with a chemical dispersing agent.

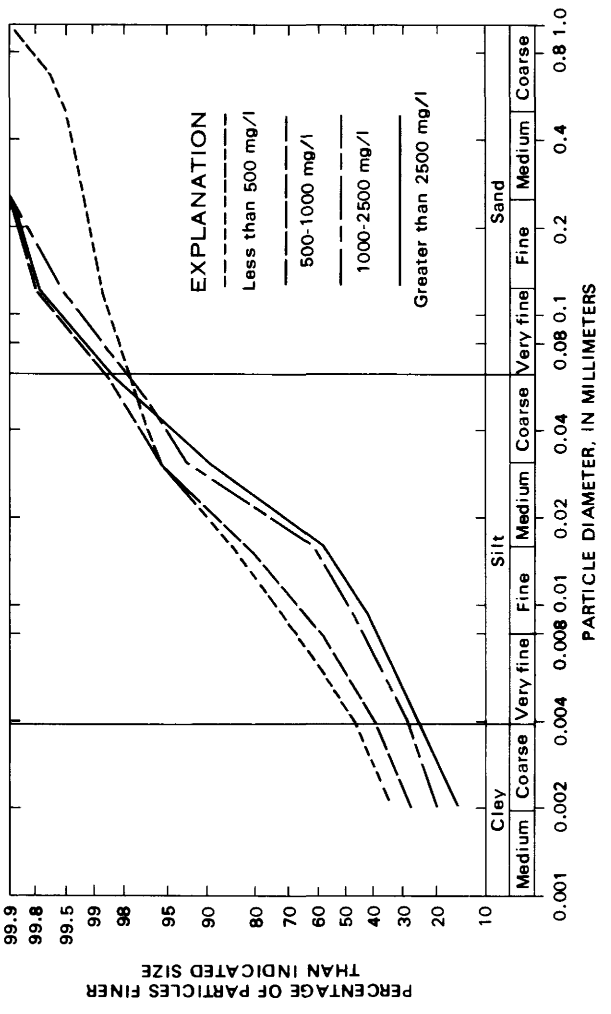

FIGURE 14.—Particle-size distribution of suspended-sediment inflow analyzed in settling medium of native water.

TABLE 4.—*Summary of particle-size analyses of inflow samples for four ranges of suspended-sediment concentration*

Concentration range (mg/l)	Percentage of clay (less than 0.004 mm)		Percentage of silt (0.004–0.625 mm)		Percentage of sand (0.625–2.00 mm)	
	Average	Range	Average	Range	Average	Range
Distilled water and dispersing agent						
Less than 500	68	50–91	29	6–46	3	0–4
500 to 1,000	60	39–88	40	12–59	.2	0–1
1,000 to 2,500	56	39–81	44	18–58	.4	0–3
More than 2,500	43	30–56	56	44–65	1	0–5
Native water						
Less than 500	47	15–74	50	24–81	3	0–12
500 to 1,000	40	22–52	59	47–77	1	0–3
1,000 to 2,500	29	9–55	69	44–89	2	0–5
More than 2,500	26	8–47	72	53–88	1.5	0–4

concentration ranges because only 11 samples were selected and the concentrations in these samples ranged from 161 to 828 mg/l. Under dispersed conditions the particle-size distribution was 88 percent clay, 12 percent silt, and 0 percent sand, whereas in the native water the distribution was 82 percent clay, 18 percent silt, and 0 percent sand.

RESERVOIR DEPOSITION

When a stream enters a reservoir, the decrease in velocity of flow reduces the stream's sediment transporting ability. The point where the velocity first decreases can be approximated by determining the upstream end of the backwater curve. "Backwater is that condition of a streamflow in which the velocity for steady flow gradually diminishes downstream and is manifested by the peculiar characteristic slope of the water surface in the direction of flow * * * "(Corbett and others, 1943, p. 132–133). In the case of a reservoir, the backwater is the result of the hydraulic gradient becoming essentially zero at the entrance to the reservoir. As the velocity decreases, the larger particles of suspended sediment are dropped. Additional deceleration results in additional deposition and the formation of a delta near the head of the reservoir. As the velocity continues to decrease, smaller and smaller particles are deposited. According to Colby (1963, p. 32–34), the thickness of a delta deposit in a stream channel increases gradually in a downstream direction to a maximum and then decreases rather abruptly at the downstream face of the delta. The size of the delta at the head of the reservoir depends primarily upon the percentage of coarser particles in the total inflowing sediment. Consequently, in the case of Plum Creek subwatershed No. 4, the delta formation is small because only a small amount of coarse sediment is transported. For small reservoirs, delta formations generally, extend only short

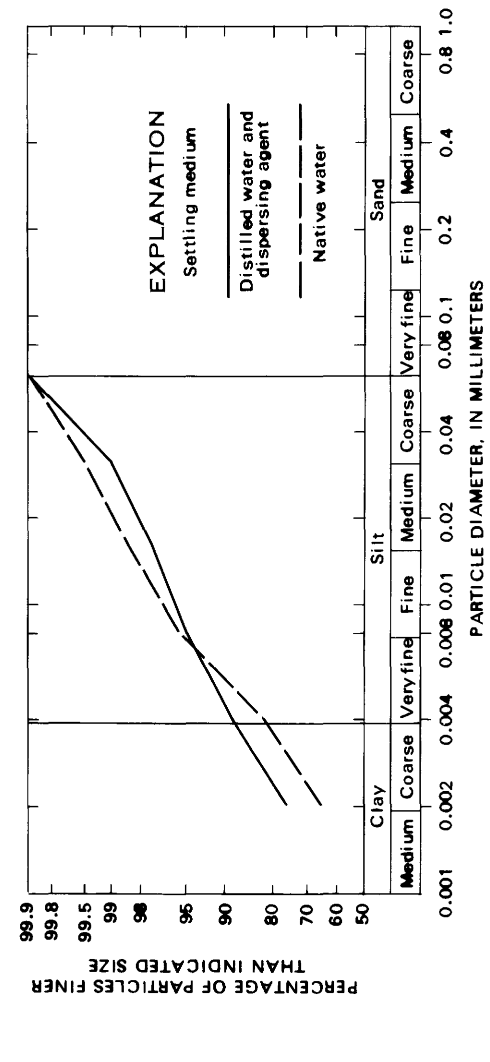

FIGURE 15.—Average particle-size distribution of suspended-sediment outflow analyzed in settling media of native water and distilled water with a chemical dispersing agent.

distances upstream from the reservoir owing to the steepness of the incoming channel slope; this condition would exist near the head of reservoir No. 4 if coarser sediment were transported.

Reservoir No. 4 is a flood-retarding reservoir, and thus when sediment is deposited in the floodwater detention part of the reservoir, the amount of floodwater that can be stored is decreased. During the investigation, however, sediment deposition caused no measurable decrease in the floodwater detention capacity.

Reservoir No. 4 was surveyed four times during the investigation in order to determine sediment deposition. The first three surveys were made by the U.S. Soil Conservation Service, Lexington, Ky., and the last survey was made by the U.S. Agricultural Research Service. The third survey, in October 1960, was incomplete because the amount of new sediment was insufficient (immeasurable). All surveys were made in detail using 10 ranges (fig. 16). A range is simply a fixed line across the reservoir, along which an adequate number of bottom elevations were determined to detect changes in the profile of the bottom of the pool. The ranges are perpendicular to a base line established along one side of the reservoir, parallel to the main valley.

Heinemann and Dvorak (1965, p. 847–851) discussed in detail the methods of surveying and procedures for computing sediment deposition in small reservoirs. For reservoir No. 4 the modified prismoidal method was used in volume computations. A summary of surveys of reservoir No. 4 is given in table 5.

The particle-size analyses of suspended sediment in the influent and effluent samples (figs. 7, 8) indicate that reservoir No. 4 retards the flow sufficiently to trap all the incoming coarse sediment and an appreciable percentage of the fine sediment. The amount of sediment deposited, however, cannot be regarded as representative of similar but unstructured areas in the Bluegrass region, for if upstream structures were absent in subwatershed No. 4, the sediment deposition in the reservoir would be appreciably higher.

TABLE 5.—*Summary of sedimentation in reservoir No. 4*

Date of survey [1]	Period years	Accumulated years	Capacity [2] (acre-ft)	Sediment deposition: During period, Acre-ft	During period, Tons	Total to date, Acre-ft	Total to date, Tons	Average dry weight (lb per cu ft)
Sept. 1954	0	0	400.07 (99.57)			0	0	
Mar. 20, 1957	2.6	2.6	392.36 (91.86)	7.71	9,910	7.71	9,910	59
Apr. 2, 1959	2.0	4.6	389.25 (88.75)	3.11	4,690	10.82	14,600	[3] 62
May 20, 1964	5.1	9.7	379.13 (78.63)	10.12	16,400	20.94	31,000	68

[1] Insufficient new sediment to measure in October 1960.
[2] Total capacity; figures in parentheses refer to sediment-pool part.
[3] Estimated.

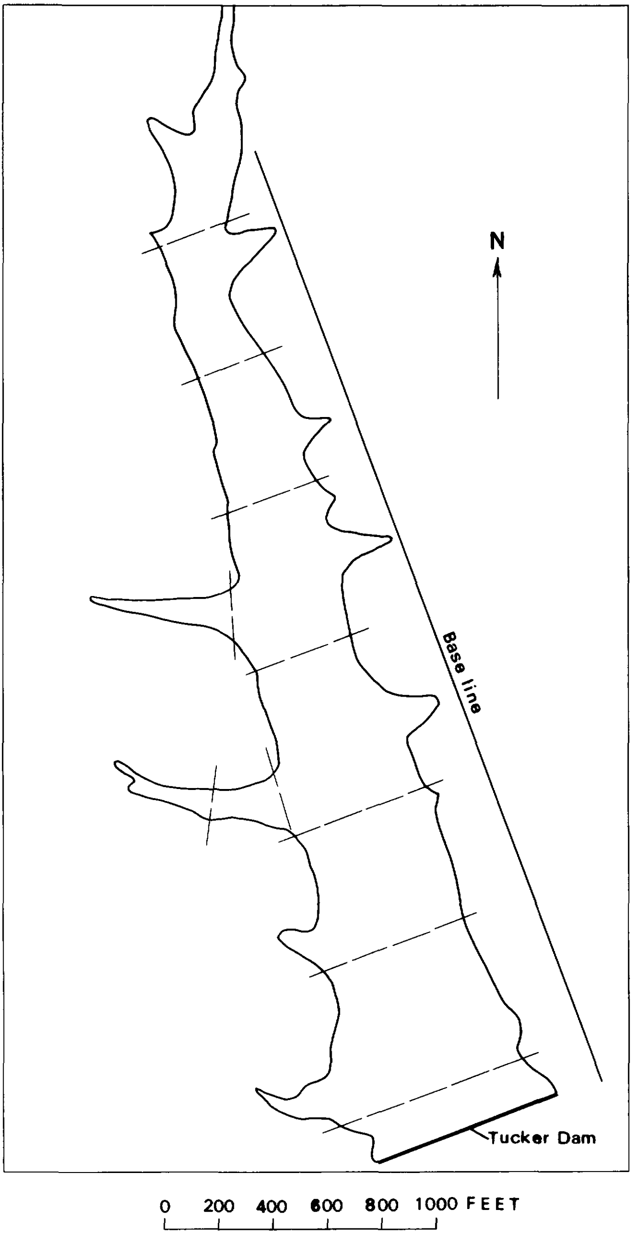

FIGURE 16.—Range layout for reservoir No. 4.

USEFUL LIFE

The useful life of reservoir No. 4 is the time required for the designed sediment-pool storage, 99.6 acre-feet, to become filled with sediment.

An estimate of useful life based on the annual rate of deposition—2.15 acre-feet per year from September 1954 to May 21, 1964—is 46 years. The actual useful life of reservoir No. 4, however, is expected to be somewhat longer than 46 years, because the amount of deposition diminishes as a reservoir fills. As the deposits fill the storage basin, less and less quiet water is available for deposition of the finer materials; thus a continually increasing part of the material entering the reservoir is carried through the outlet (Stevens, 1936, p. 220).

TRAP EFFICIENCY

The trap efficiency of a reservoir is principally dependent upon the character of sediment, the chemical character of the water, the detention storage time, and the shape of the reservoir. Trap efficiency is a ratio, expressed as a percentage, of the weight of sediment retained in a reservoir to the weight of sediment entering the reservoir. The measured trap efficiency of reservoir No. 4 was computed from the weight of sediment outflow and the computed weight of sediment deposited. During the investigation the average dry weight of sediment deposited increased from 59 to 68 pounds per cubic foot (table 5). The increase, as one would expect, is due to the compaction of the initial deposits by later deposits.

The equation used for the calibration of the trap efficiency of the reservoir is

$$TE = 100\frac{A}{A+B}$$

where

TE = trap efficiency of the reservoir, in percent,
A = weight of sediment deposited in reservoir (tons), and
B = weight of sediment discharged from reservoir (tons).

Trap efficiencies of 91 and 92 percent were determined for the periods from March 20, 1957, to April 2, 1959, and April 2, 1959, to May 20, 1964, respectively. The results are considered representative of the true trap efficiency of reservoir No. 4 for the two periods. It is emphasized, however, that these results are not representative of trap efficiencies from similar but unstructured areas in the Bluegrass region, because during normal flows reservoir No. 4 receives only the fine sediment from 28 percent of the drainage area above Tucker Dam. The trap efficiency of reservoir No. 4 in the absence of upstream structures could probably be determined by making reservoir surveys before major runoff events and after them, when water stages would be above spillway elevations of the upstream structures. These trap efficiencies would probably be somewhat higher than the trap efficiencies computed for the two periods.

To compare the measured trap efficiency of reservoir No. 4 with trap efficiencies of other reservoirs is of practical and of academic interest. The most reliable method used today for such a comparison involves a correlation of the capacity-inflow ratio (in terms of acre-feet of storage capacity per acre-foot of annual water inflow) with trap efficiency.

Brune (1953) developed a curve relating the trap efficiency to the capacity-inflow (C/I) ratio (fig. 17) for normal ponded reservoirs ("conventional reservoirs as distinguished from desilting basins and dry reservoirs") (p.411). Using the computed inflows and measured capacity of reservoir No. 4 to determine the C/I ratio, the trap efficiency, obtained from the curve, is 94 percent (C/I=0.25) for the period March 20, 1957 to April 2, 1959, and 95 percent (C/I=0.31) for the period April 2, 1959, to May 20, 1964.

The close agreement between the measured values (91 and 92 percent) and the values obtained from Brune's curve (94 and 95 percent) indicate that the trap efficiency of reservoir No. 4 is approximately equal to the trap efficiencies of reservoirs with similar C/I ratios. The upstream structures that trap significant parts of the sediment eroded from the basins containing these structures are believed responsible for the slightly lower trap efficiency of reservoir No. 4.

CONCLUSIONS

The investigation of sediment movement and deposition in Plum Creek subwatershed No. 4 from April 1, 1956, to September 30, 1964, has resulted in the following conclusions:

1. The measured trap efficiency of reservoir No. 4 averaged 92 percent during the period March 20, 1957, to May 20, 1964. During the first 2 years of the study, the trap efficiency of the reservoir was 91 prcent; during the last 5 years, the trap efficiency was 92 percent.
2. Comparison of the capacity-inflow ratio (C/I) with measured trap efficiency showed that the trap efficiency of reservoir No. 4 agreed closely with the trap efficiency of reservoirs with similar C/I ratios.
3. Because runoff from 28 percent of the drainage area above Tucker Dam must pass through upstream structures, neither the amount of sediment deposited in nor the trap efficiency of reservoir No. 4 should be regarded as representative of similar, but unstructured, areas in the Bluegrass region.
4. The principal source areas of erosion in the watershed are believed to be barnyards, plowed land, cultivated land in land capability class VI, cultivated land in Lowell soils, and pasture land with excessive grazing of cattle in land capability class VI.

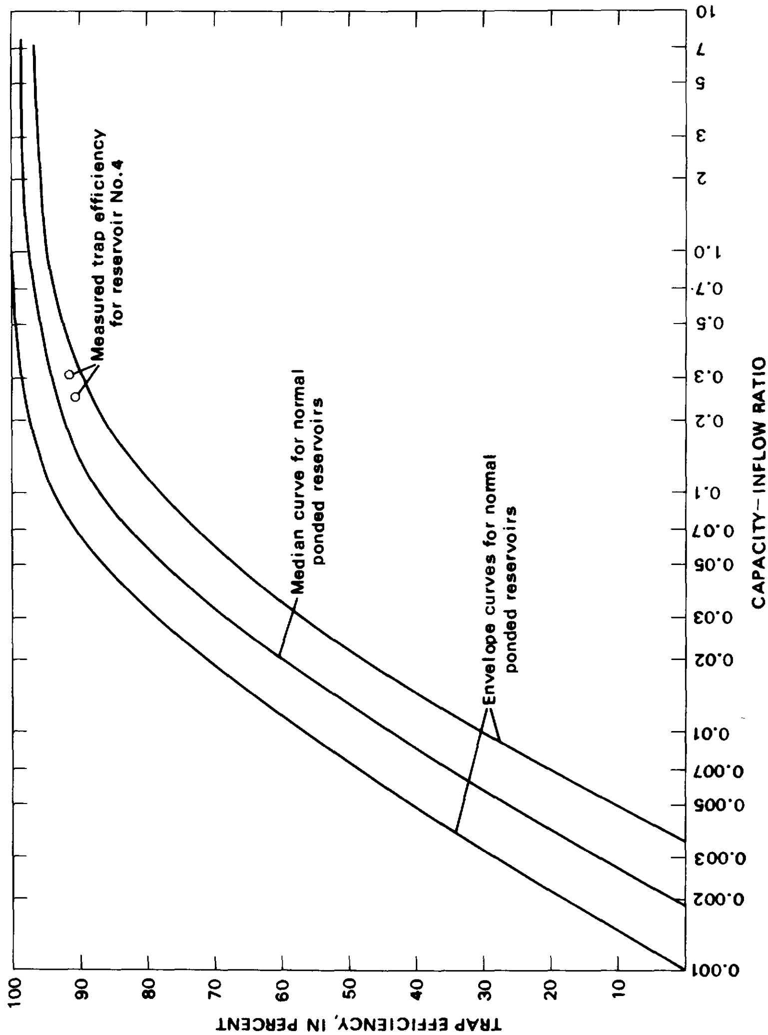

FIGURE 17.—Trap efficiency as related to capacity-inflow ratio for normal ponded reservoirs and reservoir No. 4.

5. The suspended sediment transported into reservoir No. 4 was mostly silt and clay. All the sand (generally less than 5 percent of the total sediment) and a substantial amount of the silt and clay that entered the reservoir were trapped.
6. The useful life of reservoir No. 4 based on the observed annual rate of sediment deposition is 46 years.
7. The estimated sediment yield from the 1.55 square miles of drainage area in the subwatershed was 4.03 tons per square mile per year for the period March 20, 1957, to April 2, 1959, and 5.44 tons per square mile per year for the period April 2, 1959, to May 20, 1964.
8. Runoff which produced daily mean sediment discharges from reservoir No. 4 equal to or graeter than 1,000 pounds per day accounted for 93 percent of the total 1,860 tons of sediment, but this runoff occurred only 6 percent of the time.

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TABLES 6–8

TABLE 6.—*Daily suspended-sediment records of outflow from reservoir No. 4 from 1956 to 1964*

SALT RIVER BASIN

3-2960. Plum Creek subwatershed No. 4 near Simpsonville, Ky.

LOCATION.—At gaging station at outflow of Tucker Dam No. 4, 0.2 mile upstream from mouth of tributary and 3.5 miles south of Simpsonville, Shelby County.

DRAINAGE AREA.—1.55 square miles.

EXTREMES.—Sediment concentrations: Maximum daily, 955 mg/l Mar. 31, 1962; minimum daily, 0 mg/l on many days. Sediment loads: Maximum daily, 340,000 pounds (estimated) Mar. 9, 1964; minimum daily, 0 pounds on many days.

Suspended sediment, water year October 1955 to September 1956

[Where no concentrations are reported, loads are estimated.• computed by subdividing day]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	0.6	45	146	0.1	19	10			
2	.6	51	165	.5	14	38			
3	.7	53	200	.7	9	34			
4	.8	54	233	.5	10	27			
5	.6	43	139	.3	10	16			
6	.6	29	94	.2	11	12			
7	.9	47	228	.3	15	24			
8	.8	49	211	.2	12	13			
9	.6	32	103	.1	18	10			
10	.5	38	102	.1	21	11			
11	.4	42	90	.1	18	10			
12	.4	29	62	0	0	0			
13	.3	22	36	0	0	0			
14	.4	22	47	0	0	0			
15	.7	23	87	0	0	0			
16	.8	19	82	.1	---------	10			
17	.6	20	65	.1	---------	10			
18	.6	39	126	0	0	0			
19	.4	26	56	0	0	0			
20	.3	20	32	0	0	0			
21	.2	25	27	0	0	0			
22	.2	23	25	0	0	0			
23	.2	21	23	0	0	0			
24	.2	19	20	0	0	0			
25	.1	17	9	0	0	0			
26	.3	16	26	0	0	0			
27	.4	17	37	0	0	0			
28	.3	19	31	0	0	0			
29	.2	18	19	0	0	0			
30	.2	16	17	0	0	0			
31	---------	---------	---------	0	0	0			
Total	13.9	---------	2,538	3.3	---------	225	0	---------	0
	July			August			September		
1	0	0	0	0.2	12	13	0.1	19	10
2	0	0	0	4.1	12	265	0	0	0
3	0	0	0	1.5	17	137	0	0	0
4	0	0	0	.7	9	34	0	0	0
5	0	0	0	.4	18	39	0	0	0
6	0	0	0	.2	17	18	0	0	0
7	0	0	0	.1	16	9	0	0	0
8	0	0	0	.1	16	9	0	0	0
9	0	0	0	.1	17	9	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	.4	20	43	0	0	0
15	0	0	0	.1	24	13	0	0	0
16	0	0	0	.1	24	13	0	0	0
17	0	0	0	.1	25	13	.3	20	32
18	0	0	0	.5	31	84	.2	23	25
19	0	0	0	.4	30	65	.1	16	9
20	0	0	0	.4	30	65	.1	16	9
21	0	0	0	.3	25	40	0	0	0
22	0	0	0	.2	19	20	0	0	0
23	0	0	0	.1	19	10	0	0	0
24	0	0	0	.1	15	8	0	0	0
25	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0
28	.8	8	•101	0	0	0	0	0	0
29	2.0	26	280	0	0	0	0	0	0
30	1.0	19	102	0	0	0	0	0	0
31	.5	14	38	0	0	0	---------	---------	---------
Total	4.3	---------	521	10.1	---------	907	0.8	---------	85

Maximum daily load (lb) 280, July 29.
Minimum daily load (lb) 0, many days during May to September.
Maximum daily mean concentration (mg/l) 54, April 4.
Minimum daily mean concentration (mg/l) 0, many days during May to September.
Total discharge for period (cfs-days) 32.4.
Total load for period (lb) 4,276.

Suspended sediment, water year October 1956 to September 1957

[Where no concentrations are reported, loads are estimated. •, computed by subdividing day; [a], computed from partly estimated concentration graph; [b], computed from estimated concentration graph]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	1.7	15	137	0	0	0	0	0	0
5	.9	14	68	0	0	0	0	0	0
6	.6	12	39	0	0	0	0	0	0
7	.4	12	26	0	0	0	0	0	0
8	.2	16	17	0	0	0	.1	---------	10
9	.2	19	20	0	0	0	.4	---------	45
10	.1	18	10	0	0	0	.5	---------	55
11	.1	16	9	0	0	0	.5	---------	55
12	.1	14	8	0	0	0	.5	---------	55
13	.1	12	6	0	0	0	.4	---------	45
14	0	0	0	0	0	0	1.1	---------	140
15	0	0	0	0	0	0	1.4	20	151
16	0	0	0	0	0	0	1.0	17	92
17	0	0	0	0	0	0	.8	19	82
18	0	0	0	0	0	0	.6	16	52
19	0	0	0	0	0	0	.5	18	49
20	0	0	0	0	0	0	1.2	15	97
21	0	0	0	0	0	0	2.0	15	162
22	0	0	0	.1	---------	10	1.6	15	129
23	0	0	0	.1	---------	10	1.4	14	106
24	0	0	0	.1	---------	10	1.2	15	97
25	0	0	0	.1	---------	10	.9	15	73
26	0	0	0	.1	---------	10	.8	11	47
27	0	0	0	.1	---------	10	.7	10	[b] 40
28	0	0	0	.1	---------	10	.6	10	[b] 30
29	0	0	0	.1	---------	10	.6	10	[b] 30
30	0	0	0	0	0	0	.5	10	[b] 25
31	0	0	0	---------	---------	---------	.5	10	[b] 25
Total	4.4	---------	340	0.8	---------	80	19.8	---------	1,692
	January			February			March		
1	0.4	10	[b] 20	5.8	24	750	2.8	30	453
2	.4	10	[b] 20	4.5	27	655	2.2	27	320
3	.2	10	[b] 11	3.4	26	476	1.7	21	192
4	.2	10	[b] 11	2.7	24	349	1.4	23	174
5	.3	10	[b] 16	3.3	20	356	1.2	20	129
6	.3	10	[b] 16	4.1	18	398	2.3	14	174
7	.3	10	[b] 16	3.4	15	275	3.4	16	293
8	.3	10	[b] 16	3.0	12	194	7.5	30	1,210
9	3.5	---------	600	13	35	• 3,830	6.2	22	735
10	4.3	19	[a] 440	12	76	4,920	4.5	27	655
11	2.6	17	238	5.0	46	1,240	3.7	25	499
12	2.0	14	151	3.7	32	638	3.9	36	757
13	1.6	---------	220	2.9	26	406	2.8	20	302
14	1.3	---------	170	2.4	22	285	2.2	13	154
15	.9	---------	110	1.8	18	175	1.9	13	133
16	.7	---------	80	1.6	12	103	1.5	14	113
17	.5	---------	55	1.2	10	65	1.2	12	78
18	.4	---------	45	1.1	8	47	1.0	12	65
19	.4	---------	45	.9	8	39	1.0	12	65
20	.4	---------	45	.8	12	52	.8	11	47
21	.5	---------	55	.7	12	45	.6	12	39
22	14	57	• 5,410	.6	12	39	.7	13	49
23	8.5	55	2,520	.6	12	39	.6	15	49
24	3.9	46	967	.6	13	42	.6	15	49
25	3.0	45	728	.6	23	74	.5	15	40
26	2.4	35	453	1.9	26	266	.6	15	49
27	1.9	35	358	4.1	35	773	.5	18	49
28	2.3	33	409	3.6	25	485	.4	15	32
29	3.0	30	485	---------	---------	---------	.4	15	32
30	2.7	30	437	---------	---------	---------	.4	16	34
31	2.6	29	406	---------	---------	---------	.3	19	31
Total	65.8	---------	14,553	89.3	---------	17,016	58.8	---------	7,001

Suspended sediment, water year October 1956 to September 1957—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	0.6	20	65	0.2	---------	20	0.4	---------	45
2	.9	17	82	.2	---------	20	.3	---------	30
3	2.6	26	[a] 887	.1	---------	10	.3	---------	30
4	97	422	[a] 236,000	.1	---------	10	.2	---------	20
5	9.2	325	16,100	.1	---------	10	.2	---------	20
6	5.0	274	7,380	0	0	0	.1	---------	10
7	3.7	240	[b] 4,800	0	0	0	.1	---------	10
8	22	220	[b] 26,000	0	0	0	.1	---------	10
9	5.8	156	4,880	0	0	0	.1	---------	10
10	3.9	139	2,920	0	0	0	0	0	0
11	2.9	123	1,920	0	0	0	0	0	0
12	2.2	100	1,190	0	0	0	.1	---------	10
13	1.7	75	687	0	0	0	.1	---------	10
14	1.3	52	364	0	0	0	.1	---------	10
15	.9	48	233	0	0	0	.2	---------	20
16	0.9	60	291	0	0	0	.2	---------	20
17	1.1	52	308	0	0	0	3.9	---------	700
18	1.4	45	340	0	0	0	9.2	---------	2,900
19	1.1	41	243	.1	18	[a] 10	2.9	---------	470
20	.8	---------	95	.4	---------	45	1.8	---------	250
21	.8	---------	95	4.0	16	[a] 340	.9	---------	110
22	1.1	---------	140	25	22	2,960	.7	---------	80
23	.9	---------	110	9.5	26	1,330	.6	---------	70
24	.8	---------	80	3.6	29	563	4.2	---------	800
25	.6	---------	70	2.4	---------	360	2.7	---------	430
26	.5	---------	55	1.9	---------	260	1.6	---------	220
27	.4	16	[a] 35	1.2	---------	150	.9	---------	110
28	.4	---------	45	.8	---------	95	32	---------	26,000
29	.3	---------	30	.6	---------	70	5.8	120	3,750
30	.3	---------	30	.4	---------	45	3.0	101	1,630
31	---------	---------	---------	.4	---------	45	---------	---------	---------
Total	171.1	---------	305,475	51.0	---------	6,343	72.7	---------	37,775
	July			August			September		
1	2.0	75	808						
2	1.3	50	350						
3	.8	25	108						
4	.6	---------	70						
5	.4	---------	45						
6	.3	---------	30						
7	.2	---------	20						
8	.1	---------	10						
9	.1	---------	10						
10	.1	---------	10						
11	0	0	0						
12	0	0	0						
13	0	0	0						
14	0	0	0						
15	0	0	0						
16	0	0	0						
17	0	0	0						
18	0	0	0						
19	0	0	0						
20	0	0	0						
21	0	0	0						
22	0	0	0						
23	1.2	---------	150						
24	.6	---------	70						
25	.4	---------	45						
26	.2	---------	20						
27	.2	---------	20						
28	.1	---------	10						
29	.1	---------	10						
30	.1	---------	10						
31	.1	---------	10						
Total	8.9	---------	1,806	0	---------	0	0	---------	0

Maximum daily load (lb) 236,000, Apr. 4.
Minimum daily load (lb) 0, many days during October to December and May to September.
Maximum daily mean concentration (mg/l) 422, Apr. 4.
Minimum daily mean concentration (mg/l) 0, many days during October to December and May to September.
Total discharge for year (cfs-days) 542.6.
Total load for year (lb) 392.081.

Suspended sediment, water year October 1957 to September 1958

[Where no concentrations are reported, loads are estimated. Where loads were computed from a partly estimated or estimated concentration graph, time weighted concentrations are given. • computed by subdividing day; a computed from partly estimated concentration graph; b computed from estimated concentration graph]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1	0	0	0	0.1	---------	10	0.9	---------	110
2	0	0	0	.1	---------	10	.7	---------	80
3	0	0	0	.1	---------	10	.7	---------	80
4	0	0	0	.1	---------	10	1.5	---------	200
5	0	0	0	.1	---------	10	1.5	---------	200
6	0	0	0	.1	---------	10	10	---------	3,400
7	0	0	0	.5	---------	55	40	---------	39,000
8	0	0	0	15	---------	6,800	10	---------	3,400
9	0	0	0	2.0	---------	280	3.5	---------	600
10	0	0	0	.5	---------	55	2.5	---------	380
11	0	0	0	.4	---------	45	1.5	---------	200
12	0	0	0	.3	---------	30	1.1	---------	140
13	0	0	0	15	---------	6,800	.9	---------	110
14	0	0	0	20	---------	11,000	.9	---------	110
15	0	0	0	4.0	---------	750	.8	---------	95
16	0	0	0	1.5	---------	200	.8	---------	95
17	0	0	0	.9	---------	110	1.5	---------	200
18	0	0	0	60	---------	82,000	3.5	---------	600
19	0	0	0	10	---------	3,400	30	---------	23,000
20	0	0	0	3.0	---------	490	25	---------	17,000
21	0	0	0	2.0	---------	280	6.0	---------	1,400
22	0	0	0	1.5	---------	200	3.5	---------	600
23	6.0	---------	1,400	1.0	---------	120	2.5	---------	380
24	2.0	---------	280	.9	---------	110	1.7	---------	230
25	.5	---------	55	.8	---------	95	5.0	---------	1,000
26	.3	---------	30	.7	---------	80	10	---------	3,400
27	.2	---------	20	.6	---------	70	5.0	---------	1,000
28	.1	---------	10	.6	---------	70	3.4	---------	580
29	.1	---------	10	2.0	---------	280	2.5	---------	380
30	.1	---------	10	1.5	---------	200	2.0	---------	280
31	.1	---------	10	---------	---------	---------	1.8	---------	250
Total	9.4	---------	1,825	145.3	---------	113,580	180.7	---------	98,500

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	January			February			March		
1	1.4	---------	180	4.2	30	a 650	1.8	25	243
2	1.1	---------	140	2.9	19	297	1.4	19	143
3	.90	---------	110	2.4	26	336	1.1	19	113
4	.70	---------	80	2.0	25	a 270	.95	18	92
5	.65	---------	75	2.9	19	297	.80	20	86
6	.60	---------	70	11	---------	4,000	.80	20	86
7	.60	---------	70	6.3	50	1,700	.80	20	86
8	.50	---------	55	3.4	45	825	.80	19	82
9	.40	---------	45	2.4	31	401	1.3	16	112
10	.35	---------	40	1.9	23	236	1.6	18	155
11	.35	---------	40	1.3	21	147	1.5	12	97
12	.35	---------	40	1.0	19	102	1.3	13	91
13	.35	---------	40	.80	20	86	1.3	12	84
14	1.0	---------	120	.65	20	70	1.5	12	97
15	1.2	---------	150	.65	21	74	2.0	12	129
16	1.1	---------	140	.60	19	61	2.8	12	181
17	1.1	---------	140	.45	17	41	2.7	13	189
18	.90	---------	110	.35	15	28	2.4	18	233
19	.75	---------	90	.30	15	24	2.1	22	249
20	.70	---------	80	.30	15	24	1.7	21	192
21	13	85	b 6,800	.30	13	21	1.5	20	162
22	5.9	57	1,810	.35	11	21	1.3	22	154
23	3.7	49	977	.45	10	24	1.1	19	113
24	5.6	55	b 1,700	.50	17	46	12	93	• 4,360
25	5.6	32	966	.60	20	65	4.2	128	2,900
26	3.8	30	614	.65	23	81	4.2	99	2,240
27	3.4	26	476	1.5	20	162	3.4	84	1,540
28	2.7	21	306	2.1	25	283	2.8	68	1,030
29	2.3	19	236	---------	---------	---------	2.3	38	471
30	2.0	15	162	---------	---------	---------	3.0	57	922
31	3.7	30	b 650	---------	---------	---------	3.2	45	776
Total	66.70	---------	16,512	52.25	---------	10,372	69.65	---------	17,408

Suspended sediment, water year October 1957 to September 1958—Continued

Day	April: Mean discharge (cfs)	April: Suspended sediment, Mean concentration (mg/l)	April: Suspended sediment, Pounds per day	May: Mean discharge (cfs)	May: Suspended sediment, Mean concentration (mg/l)	May: Suspended sediment, Pounds per day	June: Mean discharge (cfs)	June: Suspended sediment, Mean concentration (mg/l)	June: Suspended sediment, Pounds per day
1	2.5	33	445	4.0	66	1,420	0.20	12	13
2	2.1	30	340	3.7	47	937	.30		30
3	2.0	31	334	4.4	40	949	.20		20
4	2.3	31	384	23		31,000	.16		16
5	3.2		550	17	170	[a] 17,000	.12		12
6	7.9		2,200	14	120	[a] 9,100	.08		8
7	3.5		600	8.7	98	4,600	.05		5
8	2.6		400	4.2	76	1,720	.05		5
9	2.0		280	3.0	57	922	.05		5
10	14	70	[a] 6,300	2.5	49	660	.05		5
11	6.7	42	1,520	2.4	43	556	.04		4
12	4.2	34	770	2.0	37	399	.04		4
13	3.2	25	431	1.3	29	203	.20		20
14	2.6	26	364	.85	27	124	.20		20
15	2.1	33	374	.70	26	98	.17		17
16	1.7	36	330	.60	25	81	.12	14	[a] 9
17	1.3	33	231	.60	25	81	.10		10
18	1.1	26	154	.50	24	65	.10		10
19	.90	23	112	.35	25	47	.12		12
20	.85	27	124	.30	23	37	.15		15
21	1.4	38	287	.20	25	27	.13		13
22	1.2	33	213	.15	25	20	.10		10
23	.95	18	92	.13	27	19	.09		9
24	4.5	25	[a] 600	.12	25	16	.07		7
25	2.9	33	516	.12	28	18	.06		6
26	2.0	32	345	.10	28	15	.16	25	[b] 20
27	11	25	[a] 1,600	.09	26	13	.16	20	17
28	5.9	33	1,050	.07	18	7	.12	15	10
29	30		25,000	.05	14	4	.10	15	8
30	6.3		2,000	.03	15	2	.07	14	5
31				.02	11	1			
Total	132.90		47,946	95.18		70,141	3.56		345

Day	July: Mean discharge (cfs)	July: Suspended sediment, Mean concentration (mg/l)	July: Suspended sediment, Pounds per day	August: Mean discharge (cfs)	August: Suspended sediment, Mean concentration (mg/l)	August: Suspended sediment, Pounds per day	September: Mean discharge (cfs)	September: Suspended sediment, Mean concentration (mg/l)	September: Suspended sediment, Pounds per day
1	0.06	16	5	1.3	25	[a] 360	0.03	13	2
2	.03	15	2	24		20,000	.02	15	2
3	.02	16	2	10	60	[a] 3,800	.01	11	1
4	.01	15	1	4.0	33	711	.01	17	1
5	.01	13	1	2.6	16	226	.01	13	1
6	.01	14	1	1.8	16	155	.01		1
7	1.2	40	[b] 550	1.1	16	95	.01		1
8	2.2	30	[a] 440	.75	18	73	0	0	0
9	.95	15	77	.50	15	40	0	0	0
10	.50	23	62	.35	15	28	0	0	0
11	.70	22	83	.85		170	0	0	0
12	.80	18	78	5.9		850	0	0	0
13	.50	15	40	2.3	14	174	0	0	0
14	.30	12	19	1.3	18	126	0	0	0
15	.25	10	[a] 13	.85	20	92	0	0	0
16	1.4	19	[a] 140	.90	15	73	0	0	0
17	.90		75	.70	16	60	0	0	0
18	1.3		140	.45	17	41	0	0	0
19	1.1		90	.30	16	26	0	0	0
20	.85		80	.20	14	15	3.3		600
21	13		21,000	.19	10	10	4.2		800
22	21	100	[a] 4,200	.30	13	21	1.8	18	175
23	15	42	3,400	.20	10	11	1.0	18	97
24	5.3	25	714	.20	10	11	.65	20	70
25	10	30	[a] 2,200	.20	10	11	.45	19	46
26	2.3	32	397	.15	8	6	.35	23	43
27	1.4	35	264	.11	13	8	.50	19	51
28	1.1	18	107	.10	13	7	.35	18	34
29	.70	11	42	.07	10	4	.25	18	24
30	.35	13	25	.06	8	3	.19	18	18
31	.20	11	12	.04	13	3			
Total	83.44		34,260	61.77		27,208	13.14		1,967

Maximum daily load (lb) 82,000, Nov. 18 (estimated).
Minimum daily load (lb) 0, many days during October and September.
Maximum daily mean concentration (mg/l) 170, May 5.
Minimum daily mean concentration (mg/l) 0, many days during October and September.
Total discharge for year (cfs-days) 913.99.
Total load for year (lb) 440,064.

Suspended sediment, water year October 1958 to September 1959

[Where no concentrations are reported, loads are estimated. Where loads were computed from a partly estimated concentration graph, time weighted concentrations are reported. [a] Computed from partly estimated concentration graph; [b] computed by subdividing day]

Day	October: Mean discharge (cfs)	October: Suspended sediment, Mean concentration (mg/l)	October: Suspended sediment, Pounds per day	November: Mean discharge (cfs)	November: Suspended sediment, Mean concentration (mg/l)	November: Suspended sediment, Pounds per day	December: Mean discharge (cfs)	December: Suspended sediment, Mean concentration (mg/l)	December: Suspended sediment, Pounds per day
1	0.17		17	0.07	15	6	0.3	14	23
2	.13		13	.08	15	6	.3		30
3	.11		11	.08	15	6	.6		70
4	.10		10	.07	15	6	1.4		180
5	.08		8	.07	15	6	8.4		2,500
6	.06		6	.07	15	6	3.7		700
7	.06		6	.06	15	5	2.4		360
8	.05		4	.06	15	5	1.8		250
9	.08		8	.09	13	6	1.4		180
10	.3		30	.09	17	8	1.1		140
11	.3		30	.08	15	6	.85		100
12	.25		25	.07	17	6	.7		80
13	.2		20	.07	18	7	.6		70
14	.17		17	.06	16	5	.45		50
15	.15		15	.95		240	.4	20	43
16	.13		13	1.0	33	178	.3	16	26
17	.11		11	.70	20	75	.3	12	19
18	.10		10	.80		130	.3	3	5
19	.09		9	1.3		350	.3	3	5
20	.08		8	1.1		180	.3	4	6
21	.07		7	.85		160	.3	12	19
22	.06		6	.65	34	119	.25	11	15
23	.11		11	.55	25	74	.3	6	10
24	.13		13	.5	23	62	.35	5	9
25	.12	20	13	.4	25	54	.3	6	10
26	.11	15	9	.35	25	47	.3	5	8
27	.10	14	8	.3	25	40	.25	3	4
28	.10	14	8	.35	26	49	.25	7	9
29	.09	10	5	.35	25	47	.25	3	4
30	.08	12	5	.3	20	32	.25	6	8
31	.07	9	3				.25	10	13
Total	3.76		359	11.47		1,921	28.95		4,946

Day	January: Mean discharge (cfs)	January: Mean concentration (mg/l)	January: Pounds per day	February: Mean discharge (cfs)	February: Mean concentration (mg/l)	February: Pounds per day	March: Mean discharge (cfs)	March: Mean concentration (mg/l)	March: Pounds per day
1	1.6	26	[b] 256	1.3	18	126	1.9	28	287
2	2.5	28	377	1.1	19	114	1.6		200
3	2.0	25	270	1.1	30	[a] 180	1.5		160
4	1.5	25	202	1.7	50	458	1.3		140
5	1.0	25	135	1.5	46	372	1.8		210
6	.75	25	101	1.2	41	265	6.4	45	[a] 1,600
7	.75	25	101	1.1	33	196	3.7	45	897
8	.7	25	94	1.1	28	166	2.8	42	634
9	.65	25	88	1.1	30	178	2.7	33	480
10	.5	27	73	3.2	45	776	2.4	29	375
11	.45	28	68	2.9	55	860	2.2	26	308
12	.4	31	67	2.5	47	633	2.0	20	216
13	.4		45	4.0	38	819	1.6	19	164
14	.6		70	15		4,600	1.5	18	146
15	11		4,000	5.0	78	2,100	1.3	18	126
16	6	30	970	3.0	67	1,080	1.1	18	107
17	3.4		800	2.5		600	1.0	17	92
18	2.3		200	2.0		330	.85	15	69
19	1.8		210	1.5		240	.75	22	89
20	41		27,000	1.2		180	.75	23	93
21	64		100,000	1.0	25	135	.8	18	78
22	9.1		12,000	1.2	23	149	.65	15	53
23	4.0	155	3,340	5.0		550	.6	15	49
24	3.0	65	1,050	2.5		520	.55	16	47
25	2.5	49	660	2.0	25	270	.5	12	32
26	2.2	47	557	1.7	18	165	.5	22	59
27	2.0	45	485	1.5	15	121	.7	37	140
28	1.7	43	394	1.6	15	129	.6	34	110
29	1.7	38	348				.55	23	68
30	1.7	31	284				.6	19	61
31	1.5	23	186				.6	16	52
Total	172.70		154,431	70.5		16,312	45.80		7,142

Suspended sediment, water year October 1958 to September 1959—Continued

Day	April: Mean discharge (cfs)	April: Suspended sediment, Mean concentration (mg/l)	April: Suspended sediment, Pounds per day	May: Mean discharge (cfs)	May: Suspended sediment, Mean concentration (mg/l)	May: Suspended sediment, Pounds per day	June: Mean discharge (cfs)	June: Suspended sediment, Mean concentration (mg/l)	June: Suspended sediment, Pounds per day
1	0.55	19	56	0.08	----------	8	0.11	17	10
2	.9	22	107	.07	----------	7	.10	20	11
3	.7	----------	70	.06	----------	6	.07	12	5
4	.6	29	94	.05	----------	5	.06	14	5
5	.5	----------	120	.06	7	2	.04	12	3
6	.4	50	[a] 110	.06	8	3	.04	16	3
7	.35	37	70	.03	10	2	.04	11	2
8	.3	25	[a] 40	.02	18	2	.03	18	3
9	.3	25	40	.01	37	2	.03	20	3
10	.3	40	65	.01	29	2	.03	10	2
11	.3	46	74	.01	20	1	.02	15	2
12	.35	40	75	.04	16	3	.01	18	1
13	.35	30	57	1.2	13	[a] 133	.01	----------	1
14	.3	18	29	2.2	35	415	0	0	0
15	.25	20	27	1.1	40	237	0	0	0
16	.2	25	27	.65	30	105	0	0	0
17	.19	22	23	.5	36	97	0	0	0
18	.2	24	26	.45	26	63	0	0	0
19	.3	28	45	.45	18	44	0	0	0
20	.35	29	55	.35	11	21	0	0	0
21	.3	34	55	.45	10	24	0	0	0
22	.2	41	44	.5	21	57	0	0	0
23	.19	35	36	.4	21	45	0	0	0
24	.16	28	24	.3	22	36	0	0	0
25	.13	----------	18	.2	20	22	0	0	0
26	.11	----------	15	.17	24	22	0	0	0
27	.10	----------	10	.2	23	25	0	0	0
28	.10	----------	10	.3	19	31	0	0	0
29	.10	----------	10	.25	8	11	0	0	0
30	.09	----------	10	.19	17	17	0	0	0
31	----------	----------	----------	.15	28	23	----------	----------	----------
Total	9.17	----------	1,442	10.51	----------	1,471	0.59	----------	51

Day	July: Mean discharge (cfs)	July: Mean concentration (mg/l)	July: Pounds per day	August: Mean discharge (cfs)	August: Mean concentration (mg/l)	August: Pounds per day	September: Mean discharge (cfs)	September: Mean concentration (mg/l)	September: Pounds per day
1							0.01	----------	1
2							.03	25	[a] 4
3							.02	15	2
4							.01	17	1
5							.01	19	1
6							.01	15	1
7							0	0	0
8							0	0	0
9							0	0	0
10							0	0	0
11							0	0	0
12							0	0	0
13							0	0	0
14							0	0	0
15							0	0	0
16							0	0	0
17							0	0	0
18							0	0	0
19							0	0	0
20							0	0	0
21							0	0	0
22							0	0	0
23							0	0	0
24							0	0	0
25							0	0	0
26							0	0	0
27							0	0	0
28							0	0	0
29							0	0	0
30							0	0	0
31							----------	----------	----------
Total	0	----------	0	0	----------	0	0.09	----------	10

Maximum daily load (lb) 100,000, Jan. 21 (estimated).
Minimum daily load (lb) 0, many days during June to September.
Maximum daily mean concentration (mg/l) 155, Jan. 23.
Minimum daily mean concentration (mg/l) 0, many days during June to September.
Total discharge for year (cfs-days) 353.54.
Total load for year (lb) 188,085.

Suspended sediment, water year October 1959 to September 1960

[Where no concentrations are reported, loads are estimated. Where loads were computed from a partly estimated or estimated concentration graph, time weighted concentrations are reported. [a], computed from partly estimated concentration graph; [b], computed from estimated concentration graph; [c], computed by subdividing day; [d], less than 0.5 lb.]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1	0	0	0	0	0	0	1.1	---------	150
2	0	0	0	0	0	0	.85	---------	100
3	0	0	0	0	0	0	.65	---------	70
4	0	0	0	.04	---------	3	.50	---------	45
5	0	0	0	.30	25	[a]40	.45	---------	40
6	0	0	0	.30	25	40	.55	---------	55
7	0	0	0	.20	25	27	.50	---------	45
8	0	0	0	.17	24	22	.45	---------	40
9	0	0	0	.13	22	15	.35	---------	30
10	0	0	0	.11	22	13	.30	---------	20
11	0	0	0	.10	22	12	.45	---------	40
12	0	0	0	.09	25	12	17	---------	8,400
13	0	0	0	.08	29	12	5.3	---------	1,500
14	.01	---------	2	.17	31	[c]24	3.2	---------	700
15	0	0	0	.25	32	43	2.4	---------	460
16	0	0	0	.20	30	32	1.9	---------	330
17	0	0	0	.19	32	33	3.2	---------	700
18	0	0	0	.13	30	21	11	---------	4,400
19	0	0	0	.12	33	21	3.5	---------	800
20	0	0	0	.11	39	23	2.6	---------	500
21	0	0	0	.10	43	23	2.2	---------	400
22	0	0	0	.10	---------	25	1.6	---------	260
23	0	0	0	.15	---------	35	1.3	---------	190
24	0	0	0	1.6	---------	600	1.1	---------	150
25	0	0	0	1.2	---------	300	.90	---------	110
26	0	0	0	1.0	40	[b]240	.85	---------	100
27	0	0	0	9.9	50	[a]3,000	1.4	---------	210
28	0	0	0	3.2	30	517	9.1	---------	3,300
29	0	0	0	2.0	22	237	4.0	---------	1,000
30	0	0	0	1.4	14	106	2.9	---------	600
31	0	0	0	---------	---------	---------	2.5	---------	500
Total	0.01	---------	2	23.34	---------	5,476	84.10	---------	25,245

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	January			February			March		
1	2.0	---------	360	0.65	---------	70	1.7	19	174
2	2.1	---------	380	.55	---------	55	1.5	15	121
3	4.2	---------	1,100	.50	---------	45	1.7	11	101
4	2.7	---------	550	.55	---------	55	1.3	10	70
5	2.2	---------	400	21	---------	11,000	1.0	10	54
6	1.9	---------	300	11	---------	4,400	.85	13	60
7	1.6	---------	260	4.0	---------	1,000	.80	10	43
8	1.3	---------	190	2.9	---------	600	.65	7	25
9	.95	---------	120	2.7	---------	560	.85	7	32
10	.80	---------	95	39	---------	29,000	.80	8	34
11	.75	---------	85	5.6	---------	1,600	.75	7	28
12	.65	---------	70	3.2	---------	700	.70	5	19
13	.90	---------	110	2.7	---------	560	.65	8	28
14	18	---------	9,100	2.4	---------	460	.65	6	21
15	16	---------	7,700	2.0	---------	360	.80	5	22
16	3.8	---------	900	1.8	---------	300	3.5	5	94
17	3.0	---------	650	2.1	---------	380	5.3	6	171
18	2.2	---------	400	2.6	---------	500	6.7	14	[a]500
19	1.9	---------	330	2.2	---------	400	5.9	19	604
20	1.5	---------	230	1.7	---------	280	5.6	15	453
21	1.2	---------	170	1.6	---------	260	5.0	14	377
22	1.0	---------	130	1.6	---------	260	4.4	10	237
23	.85	---------	100	1.3	---------	190	3.7	13	259
24	.75	---------	85	1.3	---------	190	3.4	10	183
25	.60	---------	60	7.4	---------	2,400	2.7	11	160
26	.60	---------	60	4.0	---------	900	2.2	13	154
27	.70	---------	75	2.8	33	498	1.9	10	102
28	.90	---------	110	2.2	28	332	1.6	12	103
29	.90	---------	110	2.0	23	248	1.4	16	121
30	.75	---------	85	---------	---------	---------	2.3	19	236
31	.65	---------	70	---------	---------	---------	2.2	22	261
Total	77.35	---------	24,385	133.35	---------	57,603	72.50	---------	4,847

Suspended sediment, water year October 1959 to September 1960—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	1.8	23	223	0.25		25	0.25	11	15
2	1.6	15	129	.20		19	.17	9	8
3	2.7	16	233	.16		16	.16	8	7
4	3.5	14	264	.12		12	.11	10	6
5	2.9	11	172	.10		10	.10	13	7
6	2.2	16	190	.09		8	.07	11	4
7	1.8	10	97	.10		9	.04	7	2
8	1.3	7	49	.10		9	.02	7	1
9	1.0	13	70	.09		8	.01	10	1
10	.85	11	50	.09	17	8	.01	16	1
11	.65	10	35	.09	18	9	0	0	0
12	.60	7	23	.09	21	10	0	0	0
13	.50	8	22	.09	17	8	.30		50
14	.45	8	19	.07	14	5	.25		35
15	.35	9	17	.06	11	4	.20		20
16	.30	8	13	.05	14	4	.15		14
17	.30	12	19	.05	14	4	3.3	55	[a]1,000
18	.25	14	19	.02	12	11	1.4	18	136
19	.20	13	14	.02	13	1	.65	15	53
20	.19	15	15	.01	14	1	.45	15	36
21	.19	17	17	.03	14	2	.30	14	23
22	.20	13	14	.02	13	1	.20	15	16
23	.19	10	10	.01	15	1	75	400	[a]220,000
24	.16	11	9	.01	18	1	5.6	126	3,800
25	.13	8	6	.03	12	2	2.6	94	1,320
26	.30	12	19	.18		25	1.6	90	776
27	.50	20	54	2.5	25	[a]320	1.0	51	275
28	.30	15	24	1.9	17	174	14	110	[a]11,000
29	.25	18	24	.95	18	92	4.2	70	1,580
30	.25		25	.50	16	43	4.8	45	1,160
31				.35	12	23			
Total	25.91		1,875	8.33		865	116.94		241,346
	July			August			September		
1	8.3	40	[a]1,800	0.01	6	(b)	0.01	5	(b)
2	3.5	55	[a]1,000	.01	6	(b)	0	0	0
3	25	140	[a]19,000	0	0	0	0	0	0
4	5.0	128	3,450	1.6		650	0	0	0
5	1.5	52	420	2.7		900	0	0	0
6	.8	24	103	3.6	55	[a]1,100	0	0	0
7	.5	24	65	2.2	44	522	0	0	0
8	.3	19	31	1.1	16	95	0	0	0
9	.25	11	15	.60	12	39	0	0	0
10	1.0	14	75	.40	11	24	0	0	0
11	.5	13	35	.25	26	35	0	0	0
12	.25	6	8	.16	33	28	0	0	0
13	.30	6	10	.13	33	23	0	0	0
14	.30	6	10	.10	30	16	0	0	0
15	.20	5	5	.08	10	4	0	0	0
16	.13	5	4	.06	8	3	0	0	0
17	.16	5	4	.05	10	3	0	0	0
18	.09	5	2	.03	10	2	.01	35	[a]2
19	.07	5	2	.04	10	2	.01	26	1
20	.05	5	1	.12	12	8	.01	7	(b)
21	.04	5	1	.15	4	3	.01	5	(b)
22	.02	4	(b)	.12	3	2	0	0	0
23	.01	5	(b)	.10	3	2	0	0	0
24	.01	4	(b)	.08	4	2	0	0	0
25	.01	4	(b)	.06	7	2	0	0	0
26	0	0	0	.04	4	1	0	0	0
27	0	0	0	.02	4	(b)	0	0	0
28	0	0	0	.01	4	(b)	0	0	0
29	0	0	0	.01	5	(b)	0	0	0
30	0	0	0	.01	11	1	0	0	0
31	.02	5	1	.01	9	(b)	0	0	0
Total	48.31		26,042	13.85		3,467	0.05		3

Maximum daily load (lb) 220,000, June 23.
Minimum daily load (lb) 0, many days during October to November and June to September.
Maximum daily mean concentration (mg/l) 400, June 23.
Minimum daily mean concentration (mg/l) 0, many days during October to November and June to September.
Total discharge for year (cfs-days) 604.04.
Total load for year (lb) 391,156.

Suspended sediment, water year October 1960 to September 1961

[Where no concentrations are reported, loads are estimated. Where loads were computed from a partly estimated or estimated concentration graph, time weighted concentrations are reported. [a], computed from partly estimated concentration graph; [b], computed from estimated concentration graph]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1				0	0	0	0.80		95
2				0	0	0	.60		60
3				0	0	0	.45		40
4				0	0	0	.35		30
5				0	0	0	.30		20
6				0	0	0	.50		45
7				0	0	0	.95		120
8				0	0	0	.80		95
9				.13		7	.65		70
10				.50		45	.55		55
11				.45		40	.65		70
12				.30		20	.60		61
13				.25		17	.45		40
14				.20		12	.40		35
15				.17	8	7	.35		30
16				.45		160	.35		30
17				.50		230	.30		20
18				.35		130	.20		12
19				.30	70	[a] 110	.20		12
20				.25	40	[b] 55	.25		17
21				.19	30	[b] 30	.60		60
22				.20	25	[b] 25	.50		45
23				.45	30	[a] 75	.45		40
24				.40		35	.40		35
25				.35		30	.45		40
26				.30		20	1.1		150
27				.25		17	1.6		260
28				.60		60	1.3		190
29				2.4		460	1.3		190
30				1.5		230	1.1		150
31							1.2		170
Total	0		0	10.49		1,815	19.70		2,287
	January			February			March		
1	2.2		400	0.45	4	10	10	33	1,780
2	2.2		400	.45	4	10	6.7	33	1,190
3	1.8		300	.45	4	10	4.7	34	861
4	1.6		260	.45	5	12	15		6,100
5	1.8		300	.35	8	15	94		140,000
6	3.3		750	.30	22	36	82	190	[a] 84,000
7	3.8		900	2.1	30	[a] 340	7.9		3,800
8	2.9		600	7.1	40	[a] 1,500	13	140	[a] 11,000
9	2.1		380	4.9	20	528	5.3	78	2,230
10	1.6		260	3.8	19	389	3.4		750
11	1.3		190	2.9	22	344	2.9		470
12	1.1		150	2.4	21	272	2.4		320
13	.95		120	2.3	15	186	2.8		290
14	1.1		150	2.0	16	172	2.2		200
15	9.7		3,600	1.6	12	103	1.9		160
16	7.5		2,500	1.2	9	58	1.6		130
17	4.2		1,100	1.1	10	59	1.2		95
18	3.2		700	4.0	30	[a] 850	1.1		90
19	2.9		600	3.8	38	778	1.6		120
20	2.3		440	2.8	25	[b] 380	1.3		90
21	2.0		360	2.4	15	[b] 190	16	90	[a] 8,900
22	1.3		190	17	45	[a] 5,400	7.5	65	[a] 2,600
23	1.1	3	18	6.3	35	[b] 1,200	7.1	72	2,760
24	1.0	5	27	4.0	18	[b] 390	5.0	50	1,350
25	.70	6	23	30		7,300	4.0	46	992
26	.65	5	18	13		1,300	3.4	38	696
27	.60	5	16	18		2,600	2.8	35	528
28	.50	5	12	28	35	[a] 5,200	2.6	40	561
29	.45	5	12				2.1	40	453
30	.40	5	11				1.7	36	330
31	.35	4	8				3.0	40	[a] 1,000
Total	66.60		14,795	163.15		29,632	316.2		273,846

Suspended sediment, water year October 1960 to September 1961—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	12	50	[a]3,800	1.3	30	210	0.08	18	8
2	4.4	36	854	.90	28	136	.06	19	6
3	3.5	20	377	.75	18	73	.35	55	[a]110
4	2.7	26	378	.60	15	49	.35	19	[b]35
5	2.0	25	270	2.5	----------	2,200	.25	8	[b]11
6	1.6	25	216	3.7	165	3,290	3.4	----------	1,300
7	1.3	26	182	110	340	[a]240,000	8.6	----------	4,700
8	1.0	23	124	135	----------	290,000	4.0	72	1,550
9	5.8	50	[a]1,900	28	230	[a]41,000	2.7	47	684
10	7.5	----------	2,000	5.6	147	4,440	2.3	40	[b]500
11	3.8	----------	230	3.7	103	2,050	1.6	40	[b]340
12	17	----------	7,100	2.9	80	1,250	1.0	35	[b]190
13	8.5	42	1,920	2.2	65	771	.70	30	[b]110
14	5.3	30	857	1.6	55	474	16	----------	18,000
15	4.4	29	688	1.4	47	355	28	----------	18,000
16	6.7	28	1,010	.95	40	[b]200	6.3	31	1,050
17	3.7	29	578	.70	35	[b]132	3.5	28	528
18	3.4	30	550	2.5	----------	750	2.5	24	323
19	2.9	28	438	2.1	37	419	1.8	20	194
20	2.3	27	335	1.4	27	204	1.3	19	133
21	3.8	27	553	.90	27	131	.95	20	102
22	4.7	27	684	.65	15	53	.70	23	87
23	36	----------	20,000	.50	9	24	.50	26	70
24	7.1	----------	1,100	.40	8	17	.35	34	64
25	4.8	----------	670	.30	8	13	.25	35	47
26	5.0	35	[a]950	.30	7	11	.19	33	34
27	3.4	31	568	.20	8	9	.15	22	18
28	2.5	30	404	.17	14	13	.11	20	12
29	2.0	30	323	.13	15	11	.09	20	10
30	1.4	29	219	.11	13	8	.07	19	7
31	----------	----------	----------	.10	17	9	----------	----------	----------
Total	170.5	----------	49,278	311.56	----------	588,302	88.15	----------	48,223
	July			August			September		
1	0.06	18	6	0.50	19	51	0.06	----------	3
2	.04	18	4	.45	17	41	.09	----------	4
3	.03	17	[b]3	.55	18	53	.08	----------	4
4	.02	15	[b]2	.45	20	49	.07	----------	3
5	.01	15	[b]1	.30	20	32	.06	----------	3
6	.01	15	[b]1	.20	20	22	.06	----------	3
7	.01	15	[b]1	.15	20	16	.11	----------	6
8	.01	15	[b]1	.55	45	[a]240	.10	25	13
9	0	0	0	1.7	----------	280	.09	26	13
10	0	0	0	1.0	----------	130	.08	19	8
11	0	0	0	.80	----------	95	.06	16	5
12	0	0	0	1.1	----------	150	.05	----------	4
13	.01	----------	1	.85	----------	100	.03	----------	2
14	.12	----------	15	.50	----------	45	.02	----------	2
15	4.4	25	[a]600	.30	----------	20	.01	----------	1
16	2.5	27	364	.20	----------	12	.01	----------	1
17	2.8	30	[a]450	.16	----------	9	.01	----------	1
18	1.7	23	211	.13	----------	7	0	0	0
19	1.1	23	136	.15	----------	8	0	0	0
20	1.1	24	142	.11	----------	6	0	0	0
21	.75	24	97	.09	----------	4	0	0	0
22	.50	14	38	.07	----------	3	0	0	0
23	.35	13	25	.06	----------	3	0	0	0
24	.30	18	29	.08	----------	4	0	0	0
25	.75	17	69	.09	----------	4	0	0	0
26	.55	17	50	.08	----------	4	0	0	0
27	.35	18	35	.06	----------	3	0	0	0
28	.20	20	22	.05	----------	2	0	0	0
29	.16	22	19	.04	----------	2	0	0	0
30	.16	22	19	.03	----------	2	0	0	0
31	.25	21	28	.02	----------	1	----------	----------	----------
Total	18.24	----------	2,369	10.82	----------	1,398	0.99	----------	76

Maximum daily load (lb) 290,000, May 8 (estimated).
Minimum daily load (lb) 0, many days during October to November, July, and September.
Maximum daily mean concentration (mg/l) 340, May 7.
Minimum daily mean concentration (mg/l) 0, many days during October to November, July, and September.
Total discharge for year (cfs-days) 1,176.40.
Total load for year (lb) 1,012,021.

Suspended sediment, water year October 1961 to September 1962

[Where no concentrations are reported, loads are estimated. s, computed by subdividing day]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1				0	0	0	0.18	10	10
2				0	0	0	.17	9	8
3				0	0	0	.16	9	8
4				0	0	0	.7	9	34
5				0	0	0	2.5	10	135
6				0	0	0	1.0	10	54
7				0	0	0	.7	10	38
8				0	0	0	.5	9	24
9				0	0	0	10	8	431
10				0	0	0	9.5	8	410
11				0	0	0	4.0	8	172
12				0	0	0	4.5	7	170
13				0	0	0	2.4	9	116
14				0	0	0	1.7	8	73
15				0	0	0	1.4	7	53
16				.12	10	[s] 7	1.6	---------	200
17				.20	9	10	5.0	---------	1,000
18				.18	9	9	4.7	---------	950
19				.16	9	8	3.7	---------	650
20				.15	9	7	2.6	---------	420
21				.14	9	7	2.1	---------	300
22				.12	9	6	1.7	---------	230
23				.55	9	27	1.9	---------	260
24				.95	10	51	2.4	---------	360
25				.70	10	38	2.1	---------	300
26				.50	11	30	2.0	---------	280
27				.45	10	24	3.2	---------	550
28				.35	10	19	3.0	---------	500
29				.25	10	13	2.1	---------	300
30				.20	10	11	1.6	---------	200
31				---------	---------	---------	1.4	---------	170
Total	0	---------	0	5.02	---------	267	80.51	---------	8,406

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	January			February			March		
1	1.3	---------	160	1.6	---------	200	4.7	99	2,510
2	1.1	---------	130	1.5	---------	190	3.4	95	1,740
3	1.0	---------	110	1.3	---------	160	2.8	102	1,540
4	.95	---------	100	1.1	---------	130	2.7	104	1,510
5	1.5	---------	190	1.1	---------	130	2.7	94	1,370
6	9.2	---------	3,000	.80	---------	80	2.5	73	984
7	5.0	---------	1,000	.60	---------	55	2.3	60	744
8	3.5	---------	600	.60	---------	50	3.0	57	[s] 1,060
9	2.4	---------	360	3.7	---------	650	11	81	4,800
10	1.6	---------	200	3.5	---------	600	4.7	60	1,520
11	1.3	---------	160	2.5	---------	380	4.2	63	1,430
12	1.0	---------	110	2.0	---------	280	5.3	52	1,490
13	.85	---------	90	1.7	---------	230	3.4	46	843
14	.85	---------	90	1.5	---------	190	2.7	45	655
15	9.7	---------	3,300	1.3	---------	160	2.3	42	521
16	4.0	---------	750	1.5	---------	190	1.9	32	328
17	2.6	---------	420	1.3	---------	160	1.6	25	216
18	2.0	---------	280	1.2	---------	140	1.4	27	204
19	1.6	---------	200	1.1	---------	130	1.3	29	203
20	1.4	---------	170	1.0	35	189	1.5	26	210
21	2.4	---------	360	.95	32	164	9.9	53	[s] 3,180
22	43	---------	45,000	1.0	29	156	4.0	48	1,030
23	8.7	---------	2,700	31	109	[s] 50,700	3.0	49	792
24	5.0	---------	1,000	12	272	17,600	2.5	33	445
25	4.2	---------	800	5.3	247	7,060	2.1	26	294
26	7.0	---------	2,300	49	318	[s] 89,800	1.8	24	233
27	6.3	---------	1,500	47	230	[s] 65,300	1.5	24	194
28	3.5	---------	600	12	174	11,300	1.2	21	136
29	2.8	---------	440	---------	---------	---------	.95	29	148
30	2.4	---------	360	---------	---------	---------	3.2	528	[s] 16,200
31	1.8	---------	240	---------	---------	---------	15	955	[s] 95,100
Total	139.95	---------	66,720	189.15	---------	246,374	110.55	---------	141,630

Suspended sediment, water year October 1961 to September 1962—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	5.9	226	7,190	0.20	21	23	0.06	---------	3
2	3.8	56	1,150	.20	19	20	.06	---------	3
3	2.8	28	423	.18	11	11	.14	---------	8
4	2.4	17	220	1.5	10	8	.15	---------	9
5	1.9	21	215	.14	9	7	.14	---------	8
6	1.7	28	257	.11	9	5	.19	---------	12
7	1.6	17	147	.12	10	6	.16	---------	9
8	1.3	18	126	.11	10	6	.12	---------	6
9	1.1	14	83	.09	10	5	.09	---------	4
10	.95	16	82	.08	10	4	.08	---------	4
11	2.1	28	317	.50	---------	45	1.1	---------	130
12	1.9	11	113	.45	---------	40	2.1	---------	300
13	1.6	10	86	.35	---------	25	1.2	---------	140
14	1.3	11	77	.25	---------	17	.65	---------	65
15	1.1	13	77	.18	---------	11	.40	---------	35
16	.80	13	56	.14	---------	8	.30	---------	25
17	.70	14	53	.10	---------	5	.20	---------	13
18	.70	15	57	.08	---------	4	.15	---------	9
19	.60	16	52	.06	---------	3	.11	---------	6
20	.50	20	54	.04	---------	2	.09	---------	4
21	.40	20	43	.03	---------	2	.06	---------	3
22	.35	20	38	.01	---------	1	.04	---------	2
23	.35	19	36	.01	---------	1	.03	---------	2
24	.25	18	24	.01	---------	1	.03	---------	2
25	.25	17	23	0	0	0	.03	---------	2
26	.25	15	20	.01	---------	1	.03	---------	2
27	.20	14	15	.03	---------	2	.02	---------	1
28	.19	16	16	.06	---------	3	.01	---------	1
29	.16	17	15	.05	---------	3	.01	---------	1
30	.15	17	14	.07	---------	4	0	0	0
31	---------	---------	---------	.06	---------	3	---------	---------	---------
Total	37.30	---------	11,079	3.87	---------	276	7.75	---------	809
	July			August			September		
1	0	---------	0						
2	0	---------	0						
3	0	---------	0						
4	.01	---------	1						
5	0	---------	0						
6	0	---------	0						
7	0	---------	0						
8	0	---------	0						
9	0	---------	0						
10	0	---------	0						
11	0	---------	0						
12	0	---------	0						
13	0	---------	0						
14	0	---------	0						
15	0	---------	0						
16	0	---------	0						
17	0	---------	0						
18	0	---------	0						
19	0	---------	0						
20	0	---------	0						
21	0	---------	0						
22	0	---------	0						
23	0	---------	0						
24	0	---------	0						
25	0	---------	0						
26	0	---------	0						
27	0	---------	0						
28	0	---------	0						
29	0	---------	0						
30	0	---------	0						
31	0	---------	0						
Total	0.01	---------	1	0	---------	0	0	---------	0

Maximum daily load (lb) 95,100, Mar. 31.
Minimum daily load (lb) 0, many days during October to November and May to September.
Maximum daily mean concentration (mg/l) 955, Mar. 31.
Minimum daily mean concentration (mg/l) 0, many days during October to November and May to September.
Total discharge for year (cfs-days) 574.11.
Total load for year (lb) 475,562.

Suspended sediment, water year October 1962 to September 1963

[Where no concentrations are reported, loans are estimated]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1	0	0	0	0	0	0	0.08		4
2	0	0	0	0	0	0	.08		4
3	.02		1	0	0	0	.07		3
4	.02		1	0	0	0	.06	8	2
5	.02		1	0	0	0	.06		3
6	.02		1	0	0	0	.05		2
7	.03		2	0	0	0	.04		2
8	.03		2	0	0	0	.03		2
9	.02		1	0	0	0	.03		2
10	.02		1	.35		25	.02		1
11	.01		1	.45		40	.02		1
12	.01		1	.35		25	.02		1
13	.01		1	.25		17	.01		1
14	.01		1	.20		13	.01		1
15	.01,		1	.18		11	0	0	0
16	.01		1	.16		9	0	0	0
17	.01		1	.20		13	0	0	0
18	0	0	0	.35		25	.01		1
19	0	0	0	.50		45	.02		1
20	0	0	0	.45		40	.03		2
21	0	0	0	.35		25	.25		17
22	0	0	0	.35		25	.40		30
23	0	0	0	.25		17	.30		20
24	0	0	0	.19		12	.25		17
25	0	0	0	.18		11	.20		13
26	0	0	0	.15		9	.20		13
27	0	0	0	.12		6	.15		9
28	0	0	0	.11		6	.15		9
29	0	0	0	.10		5	4.4		800
30	0	0	0	.09		4	3.0		490
31	0	0	0				1.6		210
Total	0.25		17	5.33		383	11.54		1,661
	January			February			March		
1	1.1		130	0.10		5	4.6		900
2	.70		70	1.5		190	4.0		750
3	.60		55	1.8		240	2.7		420
4	.50		45	1.2		140	19.0		10,000
5	.45		40	.90		95	31.0		25,000
6	.45		40	.75		75	9.9		3,400
7	.45		40	.65		60	4.7	98	2,480
8	.35		25	.55	40	119	3.5	63	1,190
9	.35		25	.45		40	3.0	52	841
10	.35		25	.50		45	3.0	45	728
11	1.3		160	1.3		160	8.6	41	1,900
12	1.0		110	1.0		110	5.9	53	1,690
13	.60		55	.70		70	3.7		650
14	.45		40	.50		45	2.6		400
15	.35		25	.40		30	2.1		300
16	.30		20	.35		25	46.0		50,000
17	.25		17	.30		20	29.0		22,000
18	.25		17	.35		25	5.9		1,400
19	.20		13	.45		40	44.0		46,000
20	.20		13	.50	39	105	9.9	52	2,770
21	.15		9	.50		45	4.7	40	1,010
22	.15		9	.35		25	3.0	36	582
23	.15		9	.30		20	2.4	32	414
24	.15		9	.25		17	1.8	35	340
25	.10		5	.20		13	1.6	39	336
26	.10		5	.20		13	2.3		340
27	.10		5	.20	37	40	2.0		280
28	.10		5	.45		40	1.6		210
29	.10		5				1.5		190
30	.10		5				3.3		560
31	.10		5				5.6		1,200
Total	11.50		1,036	16.70		1,852	272.9		178,281

Suspended sediment, water year October 1962 to September 1963—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	3.4	---------	580	0.30	---------	20	0.16	---------	9
2	2.4	---------	360	.25	---------	17	.12	---------	6
3	1.8	---------	250	.20	---------	13	.10	---------	5
4	1.6	---------	210	.16	---------	9	.11	---------	6
5	1.3	---------	160	.14	---------	8	.15	---------	9
6	1.0	---------	110	.10	---------	5	.14	---------	8
7	.80	10	43	.08	---------	4	.10	---------	5
8	.65	---------	60	.06	---------	3	.08	---------	4
9	.60	---------	55	.04	---------	2	.06	---------	3
10	.45	---------	40	.03	---------	2	.06	9	3
11	.35	---------	25	.02	---------	1	.09	---------	4
12	.30	---------	20	.01	---------	1	.07	---------	3
13	.20	---------	13	.10	---------	5	.06	---------	3
14	.20	---------	13	.16	---------	9	.06	---------	3
15	.16	---------	9	.15	---------	9	.04	---------	2
16	.14	---------	8	.20	---------	13	.03	---------	2
17	.14	---------	8	8.5	---------	2,600	.03	---------	2
18	.11	---------	6	3.2	---------	500	.01	---------	1
19	.12	---------	6	1.6	---------	210	.01	---------	1
20	.14	---------	8	1.8	---------	250	.01	---------	1
21	.10	---------	5	1.6	---------	210	.01	---------	1
22	.14	---------	8	.95	---------	100	.01	---------	1
23	.12	---------	6	.60	---------	55	0	0	0
24	.09	---------	4	.45	---------	40	0	0	0
25	.06	---------	3	.35	---------	25	0	0	0
26	.06	---------	3	.25	---------	17	0	0	0
27	.05	---------	2	.25	---------	17	0	0	0
28	.03	---------	2	.35	---------	25	0	0	0
29	.08	---------	4	.35	---------	25	0	0	0
30	.35	---------	25	.20	---------	20	0	0	0
31	---------	---------	---------	.20	---------	13	0	0	0
Total	16.94	---------	2,046	22.75	---------	4,228	1.51	---------	82
	July			August			September		
1	0	0	0	0.03	---------	2			
2	0	0	0	.02	---------	1			
3	0	0	0	.01	---------	1			
4	0	0	0	.01	---------	1			
5	0	0	0	.01	---------	1			
6	0	0	0	0	0	0			
7	0	0	0	0	0	0			
8	0	0	0	0	0	0			
9	0	0	0	0	0	0			
10	0	0	0	0	0	0			
11	0	0	0	0	0	0			
12	0	0	0	0	0	0			
13	0	0	0	0	0	0			
14	0	0	0	0	0	0			
15	0	0	0	0	0	0			
16	0	0	0	0	0	0			
17	0	0	0	0	0	0			
18	0	0	0	0	0	0			
19	0	0	0	0	0	0			
20	0	0	0	.01	---------	1			
21	0	0	0	0	0	0			
22	0	0	0	0	0	0			
23	.01	---------	1	0	0	0			
24	.01	---------	1	0	0	0			
25	.01	---------	1	0	0	0			
26	.01	---------	1	0	0	0			
27	.01	---------	1	0	0	0			
28	.01	---------	1	0	0	0			
29	.04	---------	2	0	0	0			
30	.06	---------	3	0	0	0			
31	.05	---------	2	0	0	0			
Total	0.21	---------	13	0.09	---------	7	0	---------	0

Maximum daily load (lb)—50,000, March 16 (estimated).
Minimum daily load (lb)—0, many days during October to December and June to September.
Maximum daily mean concentration (mg/l)—98, March 7.
Minimum daily mean concentration (mg/l)—0, many days during October to December and June to September.
Total discharge for year (cfs-days) 359.72.
Total load for year (lb)—189,606.

Suspended sediment, water year October 1963 to September 1964

[Where no concentrations are reported, loads are estimated]

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	October			November			December		
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
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17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
Total	0	---------	0	0	---------	0	0	---------	0
	January			February			March		
1	0	0	0	0.15	---------	9	0.20	---------	13
2	0	0	0	.12	---------	6	.25	---------	17
3	.01	---------	1	.11	---------	6	.35	---------	25
4	.09	---------	4	.09	---------	4	78	---------	130,000
5	.09	---------	4	.08	---------	4	44	---------	46,000
6	.75	---------	75	.20	---------	13	2.9	---------	460
7	.95	---------	100	.30	---------	20	2.1	---------	300
8	.60	---------	55	.25	---------	17	18	---------	9,500
9	.85	---------	90	.25	---------	17	132	---------	340,000
10	.6	---------	55	.25	---------	17	63	---------	90,000
11	.4	---------	30	.25	---------	17	4.3	---------	800
12	.3	---------	20	.25	---------	17	2.5	---------	380
13	.2	---------	13	.25	---------	17	1.9	---------	260
14	.17	---------	10	.30	---------	20	4.4	---------	800
15	.13	---------	7	.45	---------	40	3.4	---------	600
16	.1	---------	5	1.4	---------	170	2.0	---------	280
17	.09	---------	4	1.1	---------	130	1.5	---------	190
18	.08	---------	4	.85	---------	90	1.1	---------	130
19	.14	---------	8	1.0	---------	110	.80	---------	80
20	1.2	---------	140	1.1	---------	130	.80	---------	80
21	.90	---------	95	.85	---------	90	1.6	---------	210
22	.60	---------	55	.65	---------	60	1.3	---------	160
23	.45	---------	40	.55	---------	50	.95	---------	100
24	.40	---------	30	.45	---------	40	.70	---------	70
25	.45	---------	40	.35	---------	25	3.9	---------	700
26	.35	---------	25	.35	---------	25	4.9	---------	1,000
27	.30	---------	20	.30	---------	20	1.8	---------	250
28	.20	---------	13	.30	---------	20	1.5	---------	190
29	.15	---------	9	.25	---------	17	1.1	---------	130
30	.12	---------	6	---------	---------	---------	.75	---------	75
31	.14	---------	8	---------	---------	---------	.55	---------	50
Total	10.81	---------	966	12.80	---------	1,201	382.55	---------	622,850

Suspended sediment, water year October 1963 to September 1964—Continued

Day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day	Mean discharge (cfs)	Suspended sediment: Mean concentration (mg/l)	Suspended sediment: Pounds per day
	April			May			June		
1	0.5	---------	45	1.0	---------	110	0	0	0
2	.45	---------	40	.70	---------	70	0	0	0
3	.70	---------	70	.50	---------	45	0	0	0
4	.65	---------	60	.45	---------	40	0	0	0
5	.50	---------	45	.35	---------	25	0	0	0
6	.75	---------	75	.25	---------	17	0	0	0
7	.75	---------	75	.25	---------	17	0	0	0
8	.60	---------	55	.25	---------	17	0	0	0
9	.45	---------	40	.20	---------	13	0	9	0
10	.40	---------	30	.16	---------	9	0	0	0
11	.35	---------	25	.14	---------	8	0	0	0
12	.30	---------	20	.12	---------	6	0	0	0
13	.65	---------	60	.11	---------	6	0	0	0
14	.85	---------	90	.09	---------	4	0	0	0
15	.65	---------	60	.07	---------	3	0	0	0
16	.50	---------	45	.06	---------	3	0	0	0
17	.40	---------	30	.05	---------	2	0	0	0
18	.35	---------	25	.03	---------	2	1.1	---------	130
19	.35	---------	25	.02	---------	1	1.7	---------	230
20	.50	---------	45	.01	---------	1	.85	---------	90
21	.45	---------	40	.01	---------	1	.45	---------	40
22	.90	---------	95	0	0	0	.30	---------	20
23	.95	---------	100	0	0	0	.20	---------	13
24	.65	---------	60	0	0	0	.16	---------	9
25	.45	---------	40	0	0	0	.09	---------	4
26	.55	---------	50	0	0	0	.06	---------	3
27	1.6	---------	210	0	0	0	.04	---------	2
28	2.6	---------	400	0	0	0	.02	---------	1
29	1.7	---------	230	.01	---------	1	.01	---------	1
30	1.4	---------	170	0	0	0	.01	---------	1
31	---------	---------	---------	0	0	0	---------	---------	---------
Total	21.90	---------	2,355	4.83	---------	401	4.99	---------	544
	July			August			September		
1	0.01	---------	1						
2	0	0	0						
3	0	0	0						
4	.01	---------	1						
5	.01	---------	1						
6	0	0	0						
7	.05	---------	2						
8	.65	---------	60						
9	.40	---------	30						
10	.25	---------	17						
11	.19	---------	12						
12	.19	---------	12						
13	.16	---------	9						
14	.12	---------	6						
15	.09	---------	4						
16	.07	---------	3						
17	.06	---------	3						
18	.06	---------	3						
19	.06	---------	3						
20	.08	---------	4						
21	.06	---------	3						
22	.04	---------	2						
23	.03	---------	2						
24	.03	---------	2						
25	.03	---------	2						
26	.01	---------	1						
27	.01	---------	1						
28	.01	---------	1						
29	.01	---------	1						
30	.01	---------	1						
31	0	0	0						
Total	2.70	---------	187	0	---------	0	0	---------	0

Maximum daily load (lb) 340,000, March 9 (estimated).
Minimum daily load (lb) 0, many days during October to January and May to September.
Maximum daily mean concentration not determined.
Minimum daily mean concentration (mg/l) 0, many days during October to January and May to September.
Total discharge for period (cfs-days) 440.58.
Total load for period (lb) 628,504.

TABLE 7.—*Particle-size analyses of suspended sediment in inflow to reservoir No. 4 during water years from October 1955 to September 1962*

[Instantaneous discharge: All values were computed from records of precipitation and change in reservoir storage. Method of analyses: B, bottom-withdrawal tube; S, sieve; N, in native water; W, in distilled water; C, chemically dispersed]

Date of collection	Time	Instantaneous discharge (cfs)	Suspended sediment: Concentration of sample (mg/l)	Concentration of suspension analyzed (mg/l)	Percent finer than indicated size, in millimeters — Sedimentation diameters: 0.002	0.004	0.008	0.016	0.031	Sieve diameters: 0.062	0.125	0.250	0.500	1.000	Method of analysis
1956															
May 15	1230	1.7	235	537	88	91	95	97	98	100					SBWC
July 5	1650		369	962	69	79	85	91	93	96	96	97	98		SBWC
July 15	1130		856	1,460	80	88	92	95	97	98	98	99	100		SBWC
July 16	1130		817	1,300	89	91	92	92	93	93	94	96	97		SBWC
July 16	1615		452	931	44	52	57	69	83	89	90	92	93		SBWC
July 24	1615		186	439	69	70	73	80	86	89	91	92	100		SBWC
July 28	1750		744	2,230	58	66	78	90	95	96	96	97	97		SBWC
Aug. 14	1800		229	1,010	93	96	98	98	98	99	100				SBWC
Aug. 17	1035		6,020	6,780	42	56	75	92	96	100					SBWC
1957															
Feb. 1	0945	6.6	169	621	54	67	78	88	91	96	96	97	97		SBWC
Feb. 26	1310	8.2	264	423	68	79	87	93	96	98	99	100			SBWC
Mar. 6	1015	5.5	114	391	56	67	73	83	93	97	98	99	100		SBWC
Apr. 4	1100	.19	305	542	58	69	78	87	95	98	99	100			SBWC
Apr. 8	0500	82	584	737	62	68	74	86	94	98	99	100			SBWC
Apr. 8	0530	62	853	1,490	56	63	73	84	95	99	100				SBWC
Apr. 21	1330	4.2	361	757	42	51	58	68	77	90	92	93	96		SBWC
May 19	0845	2.3	225	830	60	69	78	86	93	96	98	99	100		SBWC
May 22	0820		434	1,540	43	53	68	83	96	99	100				SBWC
June 14	1420	5.2	1,140	1,930	65	81	95	99	99	99	100				SBWC
June 22	0110		185	689	61	72	87	93	95	98	98	99	100		SBWC
June 24	2115		338	588	45	60	75	84	90	95	97	98	100		SBWC
June 28	1330	67	968	1,560	32	40	55	75	92	99	100				SBWC
Sept. 24	0900		313	580	89	93	96	98	99	99	100				SBWC
Nov. 18	0730		1,410	2,300	35	43	53	66	77	96	97	98	99	100	SBWC
Dec. 18	1750		1,090	1,980	41	51	61	79	93	99	100				SBWC
1958															
Feb. 6	1530	7.5	502	946	48	60	69	85	96	98	99	100			SBWC
Feb. 27	0900	6.7	566	1,000	49	62	80	90	98	99	100				SBWC
Mar. 24	1100		381	558	58	69	80	93	97	99	100				SBWC
Mar. 24	1600		322	1,120	43	50	62	80	94	99	100				SBWC
Mar. 30	0945	9.4	345	654	71	76	88	95	97	99	100				SBWC
Apr. 10	0915	29	450	1,670	48	59	70	86	98	100					SBWC
Apr. 10	1715	11	820	1,300	45	58	69	84	96	100					SBWC
Apr. 24	0530	15	5,140	3,970	34	47	61	83	97	100					SBWC
Apr. 24	0815	12	559	1,620	50	62	73	89	96	99	99	100			SBWC
Apr. 27	0955	25	414	707	43	54	65	85	96	98	99	100			SBWC
Apr. 29	0730	25	173	601	51	60	71	86	95	98	99	99	100		SBWC
May 2	0530		2,760	4,860	22	30	40	59	85	95	98	99	100		SBWC
May 4	0925	6.6	135	492	61	75	85	94	97	99	100				SBWC

May 6	0830	43	387	653	44	54	66	84	98	99	100			SBWC
May 6	1030	20	400	1,490	44	57	67	85	98	99	100			SBWC
July 7	1800	16	340	572	83	91	95	97	98	98	99	100		SBWC
July 21	1800	5.0	1,590	1,720	43	51	66	87	98	99	100			SBWC
July 23	0930	3.0	581	561	50	61	79	89	98	99	100			SBWC
July 25	0900	58	1,980	2,570	38	45	53	74	94	97	99	99	100	SBWC
Sept. 9	0720		655	788	52	63	79	95	98	99	100			SBWC
Sept. 26	0700		521	1,700	32	39	50	69	88	97	100			SBWC
1959														
Jan. 20	1000	154	953	893	42	49	62	82	96	99	100			SBWC
Jan. 21	1500	86	767	825	47	54	66	82	95	98	100			SBWC
Mar. 1	1200		1,050	1,730	33	41	50	68	86	97	100			SBWC
Apr. 1	1700		1,220	1,720	31	39	47	65	87	97	99	100		SBWC
Apr. 2	1800		1,070	1,370	37	44	56	75	95	99	100			SBWC
May 12	1600		414	694	49	63	71	81	94	96	98	100		SBWC
July 28	1100		306	982	46	54	65	81	93	96	98	100		SBWC
Aug. 16	1000		270	887	59	67	76	87	97	99	100			SBWC
Aug. 17	1700		190	644	80	86	92	95	98	99	100			SBWC
Aug. 18	1900		420	780	47	53	64	79	93	96	98	100		SBWC
1960														
Jan. 14	1430	24	409	789	60	71	80	94	98	98	99	100		SBWC
Jan. 14	1430	24	409	714	17	22	40	67	98	99	100			SBN
Feb. 5	1500	75	398	295	75	78	91	96	97	99	100			SBWC
Feb. 10	0700	197	1,160	798	62	75	87	91	94	98	99	100		SBWC
Feb. 10	0700	197	1,160	845	40	55	82	97	98	99	99	100		SBN
Feb. 25	1800	10	154	238	53	66	70	86	94	97	100			SBWC
Feb. 25	1800	10	154	334	37	46	63	87	97	99	100			SBN
Mar. 18	1500	16	377	1,390	45	56	72	89	99	100				SBWC
May 27	0730	5.4	388	299	84	90	97	98	98	98	100			SBWC
May 27	0730	5.4	388	380	62	74	92	96	98	98	100			SBN
June 14	1100		224	820	46	57	75	91	96	97	100			SBWC
June 23	0800	267	3,650	2,860	33	44	58	79	96	100				SBWC
June 30	0600	14	1,560	1,520	62	80	96	100						SBWC
July 3	1200	537	2,530	1,860	33	40	55	76	97	100				SBWC
July 3	1200	537	2,530	2,240	21	30	46	67	99	99	100			SBN
1961														
Feb. 22	1100	45	2,110	866	39	45	59	80	97	100				SBWC
Feb. 22	1100	45	2,110	786	19	29	47	71	94	98	100			SBN
Mar. 5	1130	140	771	447	49	56	69	84	96	99	100			SBWC
Mar. 5	1130	140	771	495	25	38	65	82	95	97	100			SBN
May 7	1400	71	1,720	936	52	63	77	92	99	100				SBWC
May 7	1400	71	1,720	919	34	47	68	89	96	98	100			SBN
June 7	1500	16	336	569	75	80	87	93	97	98	100			SBWC
June 14	2030	43	576	819	64	77	86	96	99	100				SBWC
June 14	2030	43	576	899	30	45	68	89	97	97	100			SBN
Aug. 8	1800	58	632	1,140	76	88	97	99	99	100				SBWC
1962														
Jan. 6	0800	16	317	443	55	62	70	86	97	98	100			SBWC
Jan. 6	0800	16	317	426	28	41	62	86	94	96	100			SBN
Jan. 15	0830	25	222	542	60	73	81	93	98	99	100			SBWC
Jan. 15	0830	25	222	510	32	49	70	90	97	98	100			SBN
Jan. 22	0730	125	1,060	412	50	63	77	93	98	99	100			SBWC

TABLE 8.—*Particle-size analyses of suspended sediment in outflow from reservoir No. 4 during water years from October 1956 to September 1963*

[Method of analysis: B, bottom-withdrawal tube; S, sieve; N, in native water; W, in distilled water; C, chemically dispersed]

Date of collection	Time	Instantaneous discharge (cfs)	Suspended sediment: Concentration of sample (mg/l)	Concentration of suspension analyzed (mg/l)	Percent finer than indicated size, in millimeters: Sedimentation diameters 0.002	0.004	0.008	0.016	0.031	Sieve diameters 0.062	0.125	0.250	0.500	1.000	Method of analysis
1957															
Apr. 4	1205	114	480	676	59	69	85	94	97	100					SBWC
Apr. 5	1730	10	299	525	85	90	92	95	98	100					SBWC
1960															
June 23	0800	145	782	724	68	89	97	98	99	100					SBWC
June 23	1205	138	828	785	74	88	97	99	100						SBWC
June 23	1205	138	828	810	60	78	99	99	99	100					SBN
June 28	1400	18	161	313		94	97	98	99	100					SBWC
1961															
Mar. 6	1045	135	239	488	95	98	99	99	100						SBWC
May 7	1515	152	511	1,030	74	87	96	98	99	100					SBWC
May 8	1000	135	501	999	74	86	97	99	100						SBWC
May 9	1600	11	195	386	83	91	96	97	99	100					SBWC
May 9	1600	11	195	398	56	76	94	98	99	100					SBN
1962															
Feb. 26	1400	19.6	292	584	69	89	95	98	99	100					SBWC
1963															
Mar. 12	1720		442		84	94	96	97	99	100					SBWC

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